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JPRS-CEA-84-015

23 February 1984

China Report

ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT --XXV

PLANS TO DEVELOP NATION'S MAJOR HYDROELECTRIC POWER BASES OUTLINED

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PLANS TO DEVELOP NATION'S MAJOR HYDROELECTRIC POWER BASES OUTLINED

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HYDROPOWER

THE MIN-ZHE-GAN (FUJIAN-ZHEJIANG-JIANGXI) HYDROELECTRIC POWER BASE

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 8, 12 Aug 83 pp 11-12

[Text] The Min-Zhe-Gan hydroelectric power base includes all of the provinces of Fujian and Jiangxi and the southern part of the province of Zhejiang. It contains hydraulic reserves of 23 million kilowatts capable of producing 204.43 billion kilowatt-hours of electricity (multiple year average), or 3.4 percent of the hydraulic reserves of the entire nation. The exploitable reserve comes to 16.815 million kilowatts for a multiple-year average output of 65.64 billion kilowatt-hours, or 3.5 percent of the exploitable hydraulic reserve of the entire nation.

Forty-seven large-scale and medium-scale hydroelectric power stations can be built in Fujian Province. They would have a total installed capacity of 5 million kilowatts and a yearly output of 21.2 billion kilowatt-hours of electricity. This includes the Min Jiang River Valley with its 3.47 million kilowatts, or 70 percent of the province's exploitable reserves. The Shuikou hydropower station on the mainstream of the Min Jiang will have a total installed capacity of 1,400 megawatts, making it the largest such station in all of East China. The station has excellent geological conditions and there will be relatively small loss to flooding; its installed capacity is large and its energy indices excellent. After this station has been built, it will not only resolve the electricity supply in Fujian Province but will be transmitted also to the East China Grid to regulate the peak loads there. The 300,000-kilowatt Shaxikou hydropower station, located on the Sha Xi, a tributary of the Min Jiang, will cause little loss from flooding and its construction conditions are excellent. The Jiemian hydropower station (200,000 kilowatts) on the You Xi, a tributary of the Min, the Kunkou hydropower station (96,000 kilowatts) on the Jian Xi, and the Hengtangxia hydropower station (78,000 kilowatts) will all play a regulatory role, significantly helping the Shuikou hydropower station on the mainstream to provide a sustained power output after they are built. The Mianhuatan hydropower station in the Ting Jiang River Valley in the south will have an installed capacity of 400-500,000 kilowatts and generate 1.45 billion kilowatt-hours of electricity a year. After it is completed, it can meet the electricity demand for the southwestern portion of Fujian Province and transmit power to the region of Shantou in eastern Guangdong Province. It will also reduce the threat of floods on the Chao-Shan Plateau. As sources of power go, it is one of the best in Fujian Province.

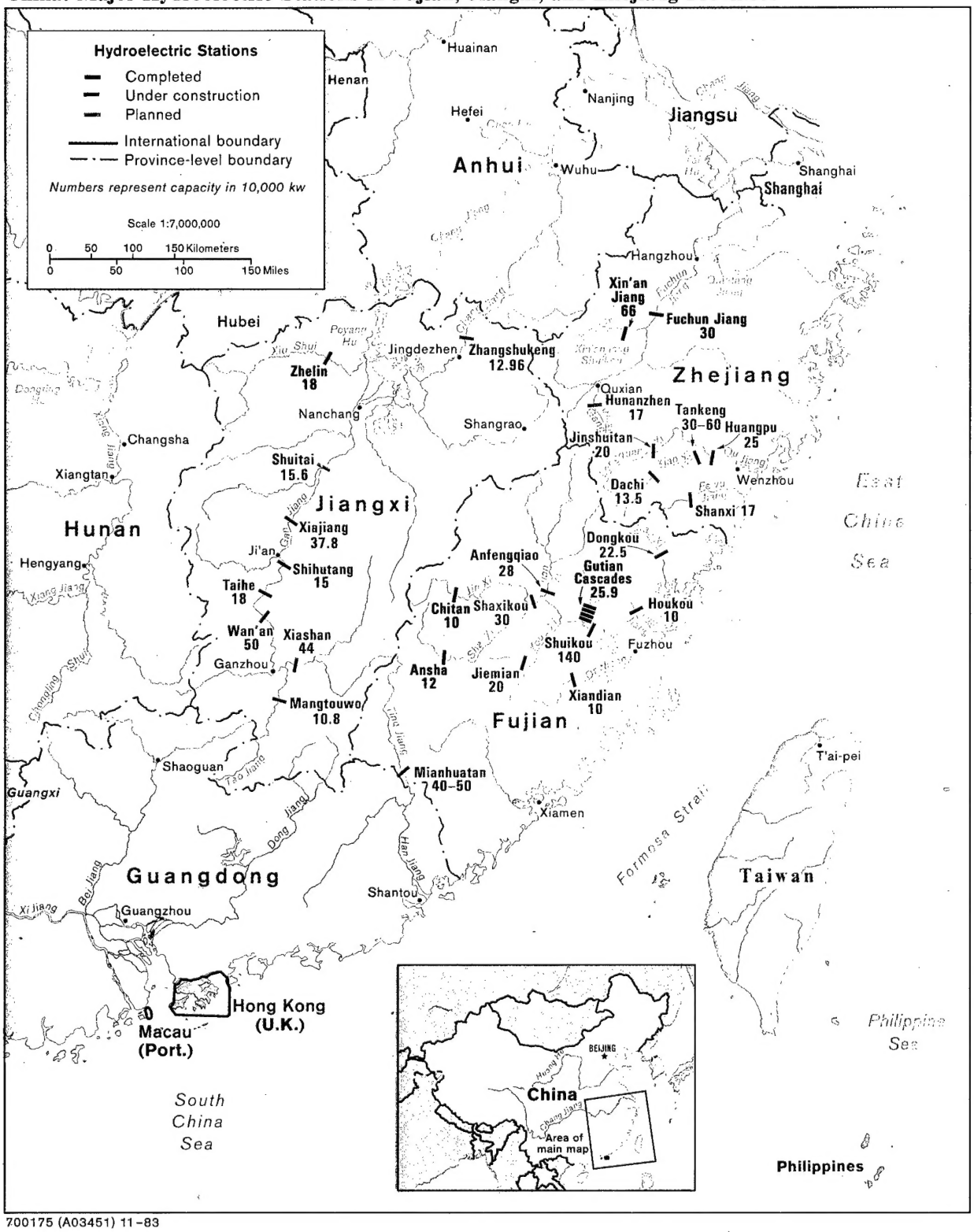
Twenty-two large-scale and medium-scale hydroelectric power stations can be built in Zhejiang Province. They would have a total installed capacity of 2.74 million kilowatts and be capable of generating 8.4 billion kilowatt-hours of electricity a year. Among these, the major stations of the Qiantang Jiang system are already operational and future emphasis will be shifted to the development of the Ou Jiang River Valley in southern Zhejiang. Power stations with a total installed capacity of 1.08 million kilowatts can be built in this river system, the major stations being Jinshuitan (200,000 kilowatts), Shitang (58,000 kilowatts), Tankeng (300-600,000 kilowatts), Huangpu (250,000 kilowatts), and Dachi (135,000 kilowatts). These hydroelectric power stations all have excellent conditions for construction, with good geological conditions for their reservoir and dam sites; the cost of construction is fairly low and, being so close to the East China Grid, the transmission distance is short; it would be economical to connect up with the grid for easy joint operation with the thermal power grid. The Shanxi hydropower station on the Feiyun Jiang in southern Zhejiang Province will be very beneficial in terms of comprehensive utilization and is one of the larger medium-sized hydroelectric power stations in Zhejiang Province.

Thirty-three large-scale and medium-scale hydroelectric power stations can be built in Jiangxi Province. They would have a total installed capacity of 3.44 million kilowatts and be capable of generating 12 billion kilowatt-hours of electricity a year. Among these, 2.56 million kilowatts could be developed on the Gan Jiang, which represents 74 percent of the exploitable capacity of the entire province and will be emphasized for future development. The Gan Jiang plan calls for nine cascades, including Xiashan (440,000 kilowatts), Wan'an (500,000 kilowatts), and Xiajiang (378,000 kilowatts), three hydroelectric power stations that will play a major regulatory role; although the energy benefits will be outstanding, the loss due to flooding will be extensive.

The Min-Zhe-Gan hydroelectric power base was the earliest of these bases in China. Up to the end of 1981, this hydroelectric power base already had 18 large- and medium-scale power stations with an installed capacity of 2.09 million kilowatts and a yearly output of 7.4 billion kilowatt-hours of electricity. Of these [18 stations], nine, with an installed capacity of 600,000 kilowatts, are in Fujian Province; five, with an installed capacity of 1.18 million kilowatts, are in Zhejiang Province, and four, with an installed capacity of 310,000 kilowatts, are in Jiangxi Province. The principal stations are:

Gutian cascade stations on the Min Jiang	(259,000 kilowatts)
Ansha station on the Sha Xi	(120,000 kilowatts)
Chitan station on the Futun Xi	(100,000 kilowatts)
Hua'an station on the Jiulong Jiang	(60,000 kilowatts)
Xin'anjiang station on the Qiantang Jiang System	(660,000 kilowatts)
Fuchun Jiang station	(300,000 kilowatts)
Wuxi Gang cascade stations	(200,000 kilowatts)
Zhelin station on the Xiu Shui	(180,000 kilowatts)
Shangyoujiang station on the Gan Jiang	(60,000 kilowatts)

China: Major Hydroelectric Stations in Fujian, Jiangxi, and Zhejiang Provinces



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Three large-scale and medium-scale hydropower stations are currently under construction. They have a total installed capacity of 1 million kilowatts and include the Shaxikou hydropower station (300,000 kilowatts) in Fujian Province, the Jinshuitan hydropower station (200,000 kilowatts) in Zhejiang Province, and the Wan'an hydropower station (500,000 kilowatts) in Jiangxi Province.

Of the future major development projects on the mainstream of the Min Jiang and on the Ting Jiang in Fujian Province, the initial planning on the Shuikou hydropower station has been completed, and the stage is set for construction to get under way in the near future; survey and design work is now under way on the Mianhuatan hydropower station. The survey and design work on major development projects in Zhejiang Province--Ou Jiang, Tankeng, and Shitang--is under way; initial planning work on the Shanxi hydropower station has been completed, and survey and design revisions are now under way. Planning for the Gan Jiang River Valley in Jiangxi Province is now being vigorously pushed ahead.

CSO: 4013/52

HYDROPOWER

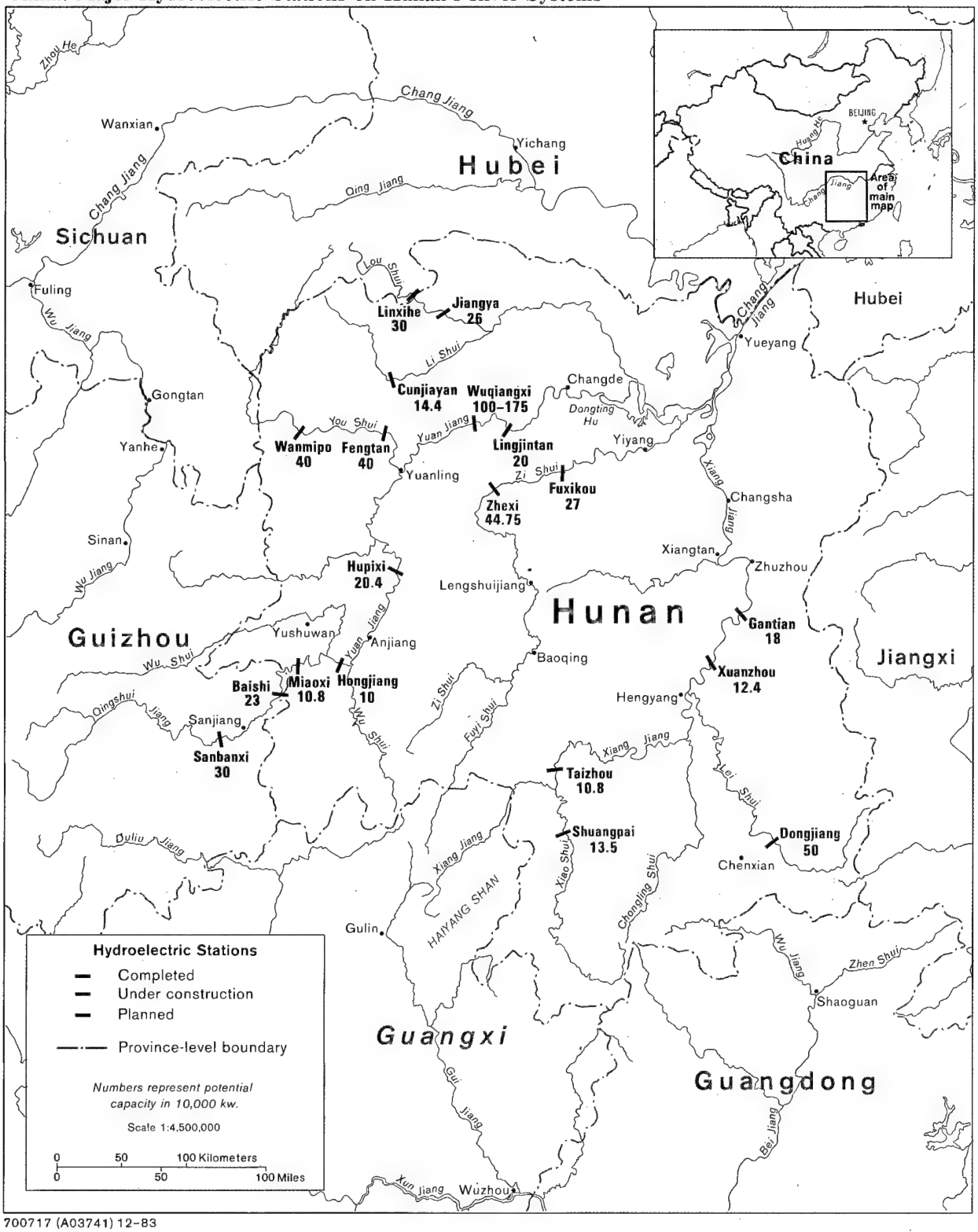
THE WESTERN HUNAN HYDROELECTRIC POWER BASE

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 10, 12 Oct 83 pp 12-13

[Text] The Western Hunan Hydroelectric Power Base encompasses Dongting Hu's Xiang Jiang, Zi Shui, Yuan Jiang, and Li Shui river systems which cover a total area of 262,823 square kilometers, of which 204,843 square kilometers, or 78 percent, lie within the boundaries of Hunan Province. Some 30,401 square kilometers, or 11.6 percent, lie within Guizhou Province. The remaining 27,579 square kilometers, or 10.4 percent, lie within the provinces (regions) of Guangxi, Sichuan, Hubei, Jiangxi, and Guangdong provinces. Western Hunan's hydraulic resources are enormous and the theoretical reserves of the four river systems come to 18.61 million kilowatts. The major portion (13.62 million kilowatts) of these reserves is in Hunan Province with the rest in Guizhou Province.

The Xiang Jiang has its source in the Haiyang Mountains in Guangxi Province and the river system covers an area of 94,660 square kilometers, or 36 percent of the area encompassed by the four river systems. The mainstream of the Xiang Jiang has a total length of 844 kilometers and a drop of 956 meters, with numerous tributaries. The total theoretical hydraulic reserve of the system is 5,218,000 kilowatts, of which the tributaries account for 4,306,000 kilowatts, or 82.5 percent of the total. The mainstream accounts for only 17.5 percent. The river system's hydroelectric power stations with an installed capacity of 100,000 kilowatts and more include Taizhou (108,000 kilowatts), Xuanzhou (124,000 kilowatts), Gantian (180,000 kilowatts), Shuangpai (135,000 kilowatts), and Dongjiang (500,000 kilowatts). The Dongjiang Reservoir is the best large reservoir serving a regulatory role in Southern Hunan. The independent operation of the Dongjiang Hydroelectric Power Station will guarantee an output of 123,000 kilowatts, playing a supplementary and regulatory role for the other hydropower stations within this system, and raising the guaranteed output of these stations to 300,000 kilowatts. The Dongjiang Hydroelectric Power Station is located on the Lei Shui, the largest tributary of the Xiang Jiang. Initially, the Lei Shui can be divided into 13 cascades with a total installed capacity of 1.1 million kilowatts, a guaranteed output of 767,000 kilowatts, and an annual output of 3.24 billion kilowatt-hours of electricity. The Lei Shui constitutes a rich source of hydrualic reserves for the Xiang Jiang river system.

China: Major Hydroelectric Stations on Hunan's River Systems



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The Zi Shui river system covers an area of 28,142 square kilometers, or 10.7 percent of the area encompassed by the four river systems; only the valley of the tributary Nan Shui covers any significant area, the others being very small. The mainstream of the Zi Shui has a length of 713 kilometers and a drop of 970 meters. Hydraulic reserves come to 2.24 million kilowatts. The river system's hydroelectric power stations with an installed capacity of 100,000 kilowatts and more include Zhexi (447,500 kilowatts) and Fuxikou (270,000 kilowatts). The Fuxikou Hydroelectric Power Station is located some 60 kilometers downstream from Zhexi and controls the area of heavy rainfall below the Zhexi power station. In addition to generating electricity, the Fuxihou stations will operate in concert with the Zhexi Reservoir to bring the flood control capability up to the point where 30-year flood crests can be handled. At the same time, water can be diverted to irrigate vast acreage on the downstream left bank of the river.

The source of the Yuan Jiang is in the Yunwu Mountains of Guizhou Province. This river system covers an area of 89,160 square kilometers, or 34 percent of the area encompassed by the four river systems, and is second only to the Xiang Jiang. The mainstream is 1,022 kilometers in length and has theoretical reserves of 7.94 million kilowatts, the richest of the four rivers in terms of hydroelectric resources. The river system's hydroelectric power stations with an installed capacity of 100,000 kilowatts and more include Sanbanxi (300,000 kilowatts), Baishi (230,000 kilowatts), Miaoxi (108,000 kilowatts), Hongjiang (100,000 kilowatts), Hupixi (204,000 kilowatts), Wuqiangxi (1 million to 1.75 million kilowatts), Lingjintan (200,000 kilowatts), Wanmipo (400,000 kilowatts), and Fengtan (400,000 kilowatts). The Wuqiangxi Hydroelectric Power Station is located on the lower course of the Yuan Jiang and controls 93 percent of the area of the river valley. In addition to generating power, it will enhance flood control and shipping and will be the largest hydropower station in the western Hunan hydropower base. Wanmipo is located on the middle course of the You Shui and controls an area of 9,610 square kilometers and at the ordinary water storage level of 300 meters, the volume of the reservoir will be 3.1 billion cubic meters. Performing a multiyear regulatory function, when completed it will not only generate power, but also guarantee an increased output of 200,000 kilowatts from the two downstream hydropower stations of Fengtan and Wuqiangxi.

The Li Shui river system covers an area of 18,500 square kilometers, or 7 percent of the area encompassed by the four river systems, the smallest in terms of area. The theoretical hydraulic reserve of the Li Shui comes to 2.05 million kilowatts, most of it distributed along the tributaries. The river system's hydroelectric power stations with an installed capacity of 100,000 kilowatts and more include Cunjiayan (144,000 kilowatts), Linxihe (300,000 kilowatts), and Jiangya (260,000 kilowatts). Jiangya will operate in concert with the Cunjiayan and Zaoshi reservoirs, possibly resolving the problem of flooding along the lower course of the Li Shui.

The Western Hunan hydroelectric power base has enough exploitable hydraulic resources to support 71 hydropower stations with an installed capacity of 25,000 kilowatts and more for a total installed capacity of 8.85 million kilowatts and a guaranteed output of 2.62 million kilowatts and an annual capacity of 40.9 billion kilowatt-hours. The river system's hydroelectric

power stations with an installed capacity of 100,000 kilowatts and more total 19 in number with a total installed capacity of 6.16 million kilowatts. Five of these stations are on the Xiang Jiang, two are on the Zi Shui, nine are on the Yuan Jiang, and three are on the Li Shui.

Large- and medium-scale hydroelectric stations already built in western Hunan include Zhexi (447,500 kilowatts), Fengtan (400,000 kilowatts), Shuangpai (135,000 kilowatts) Huamuqiao (54,000 kilowatts) (Ouyanghai (36,000 kilowatts), Shuifumiao (30,000 kilowatts), and Chunyangtan (35,200 kilowatts) with a total installed capacity of 1,137,700 kilowatts. Two hydroelectric power stations are currently under construction. These are Dongjiang (500,000 kilowatts) and Majitang (55,000 kilowatts) with a total installed capacity of 55,000 kilowatts. A great amount of survey and design work has been done on the Wuqiangxi hydropower station but due to the large loss that would be caused by flooding, studies are now underway on a national scheme to scale down the project, and thereby the loss from inundation, in order to begin construction at the earliest possible moment.

Among the cascade power stations on the Lei Shui, the Little Dongjiang hydropower station (40,500 kilowatts) below the Dongjiang station, is a counter-regulatory reservoir for the larger project. There is also the Yaotian hydropower station (50,000 kilowatts) near Leiyang. Studies are now underway on resuming work on this project, a significant portion of which was completed in the past. Also, the Sanjiangkou hydropower station on the Li Shui (62,500 kilowatts) has been partially finished and preparations are being made to resume work in the next few years.

CSO: 4013/30

HYDROPOWER

THE WU JIANG HYDROELECTRIC POWER BASE

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 2, 12 Feb 83 pp 7-8

[Summary] The Wu Jiang is one of the main tributaries on the upper course of the Chang Jiang. The river valley covers 87,900 square kilometers and the main stream from Huawuji to the mouth of the river is 712 kilometers long. The natural drop of the river channel is 725 meters and the mean flow volume at the mouth is 1,650 cubic meters/second measured over many years. The average runoff as measured over many years is 52 billion cubic meters. The hydraulic reserve of the whole river valley is 14,000,000 kilowatts, which translates into an installed capacity of 8,340,000 kilowatts and an annual output of 41.6 billion kilowatt-hours, or 4 percent of the national total. The installed capacity of exploitable hydraulic resources of the main stream segment of the Wu Jiang is 5,590,000 kilowatts for an annual output of 28 billion kilowatt-hours. The conditions for development of the hydraulic resources of the Wu Jiang are superior, making it one of the key rivers to be developed in the next 20 years. The development of the Wu Jiang is mainly to generate electricity with considerations for shipping, flood prevention, and irrigation. The main cascade hydroelectric power stations are near the power consuming centers of Guiyang and Chongqing. The river is a tributary of the upper course of the Chang Jiang closest to the central China region. Promoting the development of the Wu Jiang can satisfy local power needs in the near future. When necessary, power can also be supplied to the central China region. The reserves of bauxite, coal, and phosphorus in Guizhou Province are abundant and after the Wu Jiang is developed, electricity can supply the demand for smelting, manufacturing, and refining operations requiring the consumption of large amounts of electricity. Although loss from flooding by the cascade stations on the main stream of the Wu Jiang will be minor and the amount of construction work is relatively small, over 70 percent of the area of the river valley is soluble geostrata, with well-developed karst. This presents geological and hydrogeological problems at the proposed dam and reservoir sites. But with the experience gained in constructing the cascade power stations on the Maotiao He, and in building Wujiangdu, all in karst regions, the problems are viewed as ones that can be solved.

The development plan for the main stream of the Wu Jiang tentatively calls for the development of eight cascade stations: Dongfeng (390,000 kilowatts), Suofengying (150,000 kilowatts), Wujiangdu (630,000 kilowatts),

Goupitan (2,000,000 kilowatts), Wenjiadian (400,000 kilowatts), Silin (170,000 kilowatts), Shatuo (650,000 kilowatts), and Pengshui (1,200,000 kilowatts). Total installed capacity is 5,590,000 kilowatts, with a guaranteed output of 1,670,000 kilowatts, and an annual output of 28 billion kilowatt-hours. The first seven of the eight hydroelectric power stations are in Guizhou Province. The last cascade station, the Pengshui Hydroelectric Power Station, is in Sichuan Province.

At present, the six cascade hydroelectric power stations (242,000 kilowatts) on the Maotiao He, a tributary of the Wu Jiang, have been completed. The Wujiangdu Hydroelectric Power Station on the main stream of the Wu Jiang has also been completed.

Backbone hydroelectric power stations on the main stream of the Wu Jiang are the Goupitan and Pengshui stations. The former is situated in Yuqing County, Guizhou Province and has the largest reservoir capacity and the largest installed capacity of all the cascade stations on the main stream of the river. The reservoir capacity constitutes 55 percent of the total reservoir capacity of the cascade stations and the installed capacity constitutes 36 percent. Besides providing more electricity, it will also serve shipping and flood prevention. The Pengshui Hydroelectric Power Station is second in size only to Goupitan of the cascade stations on the main stream of the Wu Jiang. It is situated at the mouth of a narrow gorge 1 kilometer from the seat of Pengshui County, Sichuan Province. The geological conditions are good, the dynamic energy indices are superior, and transportation is convenient. Survey and design work is now being carried out for these two hydroelectric power stations. Dongfeng and Wenjiadian are two medium hydroelectric power stations on the main stream of the Wu Jiang. Much survey and design work has been done on them as well. The Dongfeng Hydroelectric Power Station is only 70 kilometers from Guiyang. With good construction conditions, it is suitable for near-term development.

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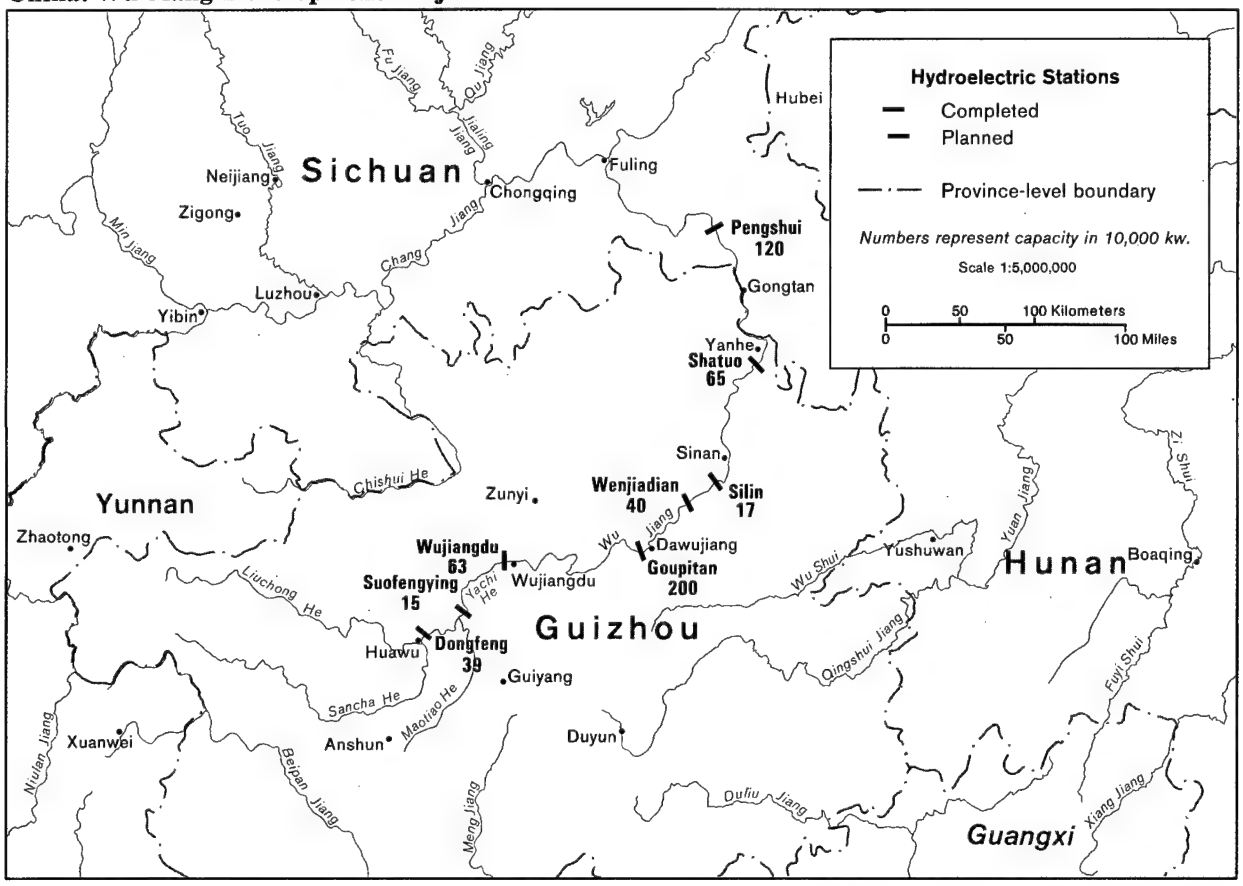
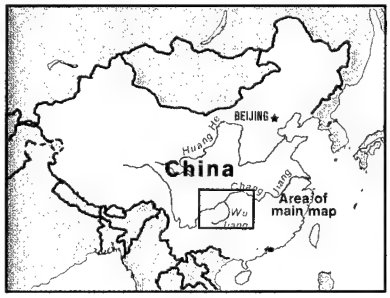
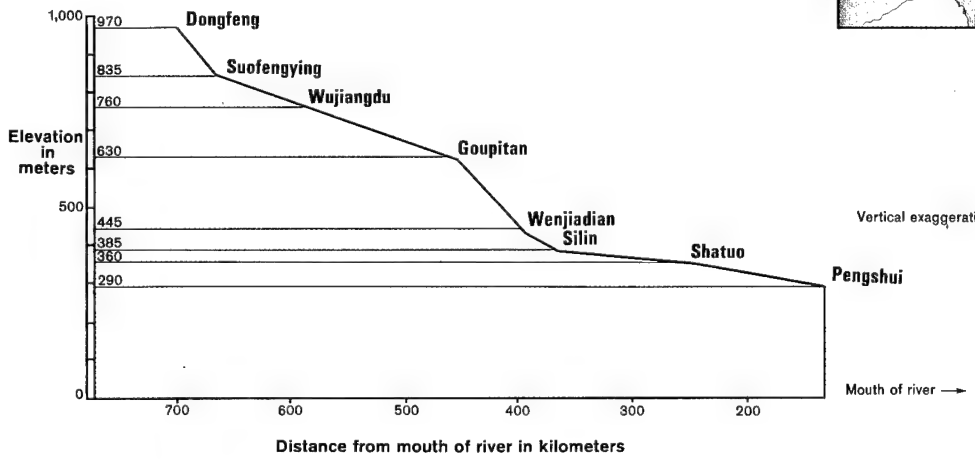
China: Wu Jiang Development Project





Wu Jiang Profile



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HYDROPOWER

THE HONGSHUI HE HYDROELECTRIC POWER BASE

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 4, 12 Apr 82 pp 15-20

[Summary] Originating in the Yunnan-Guizhou Plateau, the Hongshui He is a section of the larger Xi Jiang in the Zhu Jiang River Valley. The upper course of the Hongshui He is called the Nanpan Jiang. The Nanpan Jiang flows through Yunnan Province and into Guizhou where it converges with the Beipan Jiang to form the Hongshui He. The area encompassed by the Hongshui He Comprehensive Utilization Plan includes the Nanpan Jiang from its union with the Huangni He to its convergence with the Beipan Jiang, the Hongshui He, and the Qian Jiang as far as Datengxia. The total length of these river courses is 1,050 kilometers and the total drainage area is 190,000 square kilometers.

Located in a subtropical region, the river valley is characterized by mild climate and abundant rainfall (1,200 mm a year in the upper sections, 1,500 to 1,800 mm a year in Guangxi). The average volume of flow recorded at Datengxia is 130 billion cubic meters a year, three times that of the Huang He in an area only one-fourth as large. Elevation at the confluence of the Nanpan Jiang and the Huangni He is approximately 780 meters, dropping to 23.5 meters at the site of the Datengxia dam during the dry season. The most concentrated drop occurs at Leigongxia, below Tianshengqiao, where the river descends 181 meters over a 14.5 kilometer stretch for an average drop of 12~13 meters per kilometer. Developmental plans now call for ten cascades: Tianshengqiao High Dam, Tianshengqiao Low Dam, Pingban, Longtan, Yantan, Dahua, Bailongtan, Etan, Qiaogong and Datengxia.

Plans call for a total installed capacity of some 11 million kilowatts with an annual power generation capacity of 60 billion kilowatt-hours, broken down as follows among the major projects:

Tianshengqiao High Dam	(1,080,000 kilowatts)
Tianshengqiao Low Dam	(1,240,000 kilowatts)
Pingban	(360,000 kilowatts)
Longtan	(4,000,000 kilowatts)
Yantan	(1,400,000 kilowatts)
Dahua	(400,000 kilowatts)*
Bailongtan	(180,000 kilowatts)
Etan	(60,000 kilowatts)**
Qiaogong	(500,000 kilowatts)
Datengxia	(1,200,000 kilowatts)

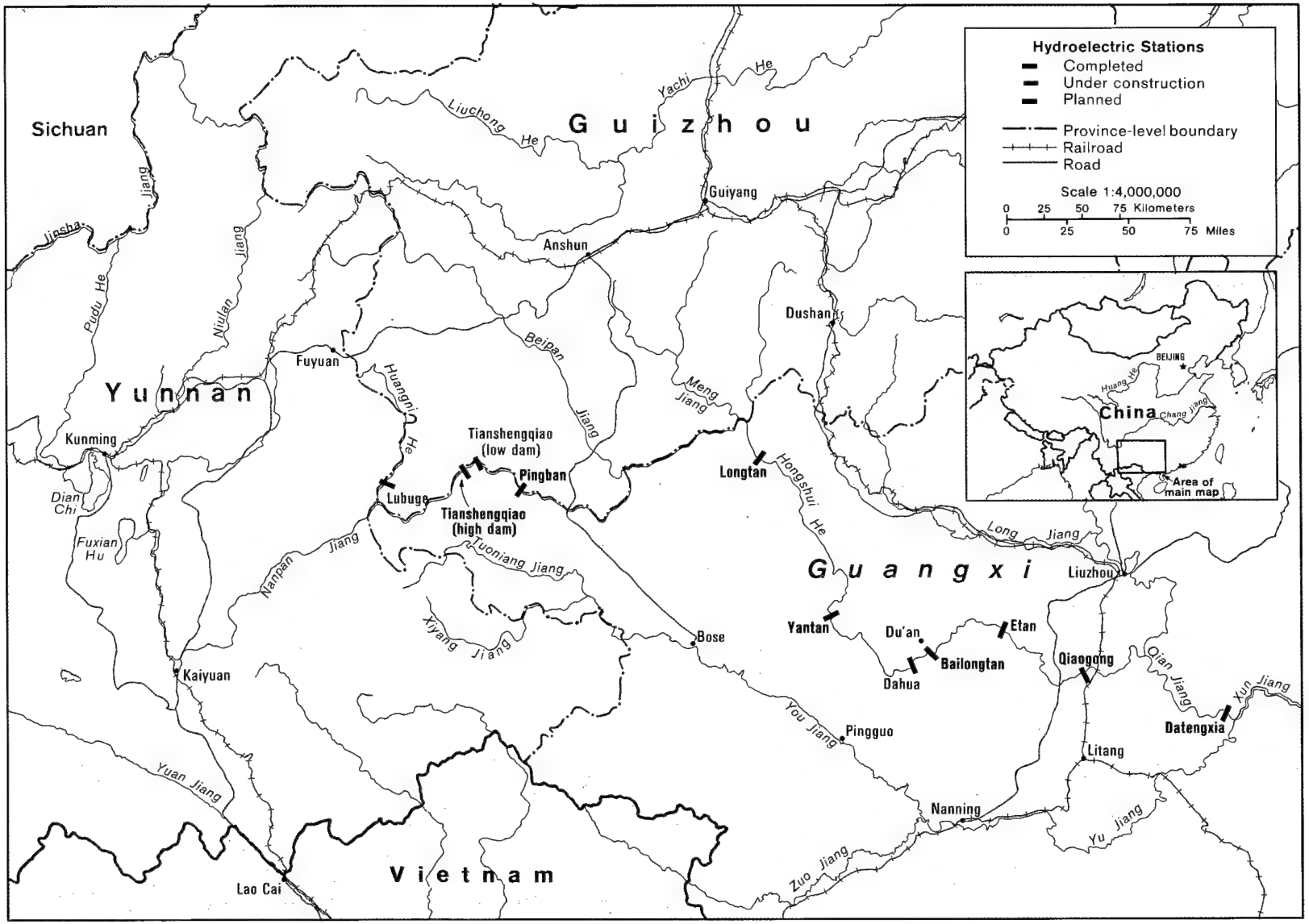
* Plans call for 600,000 kilowatts after completion of Longtan.
** Plans call for 560,000 kilowatts after completion of Longtan.

The latest plan (1980) estimates that some 164,300 mu of cropland will be inundated and more than 180,000 people displaced by the project, a far more acceptable loss than that envisioned in previous plans, which stressed flood control incorporating low- and medium-head dams.

In this most recent plan, Tianshengqiao and Longtan will be developed after Dahua. Datengxia will follow Longtan, which will play a regulatory role. Longtan, which will control most of the river, is the kingpin of this scheme. Once it has been built, construction of the projects below it will be facilitated and their operating conditions enhanced. As this project requires an enormous amount of investment, its construction, along with Datengxia, has been delayed and the decision was made to go with the construction of Tianshengqiao first. Tianshengqiao requires much less capital investment, will inundate less land, can be built quickly and show faster economic return. Thus the Tianshengqiao Low Dam will be constructed first to be followed by Yantan, the High Dam, and Dahua. Longtan and Datengxia are next on the agenda. These power stations will come on stream in the period covered in the 7th to 10th 5-year plans and all are expected to be completed and operational by 2005.

CSO: 4013/61

China: Hongshui He Development Project



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THE LANCANG JIANG HYDROELECTRIC POWER BASE

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 7, 12 Jul 83 pp 6-8

[Summary] The Lancang Jiang hydropower base is the second largest-hydropower base among China's ten big hydropower bases, exceeded in size only by the Jinsha Jiang project.

The Lancang Jiang originates on the northern slopes of the Tanggula Mountains in Qinghai Province, and flows through Tibet on its way into Yunnan Province. At Nanla He in Yunnan's Xishuangbanna Autonomous Prefecture, it flows out of the national boundary and is thereafter known as the Mekong River. Within China, its tributaries are short and have small drainage areas, with only three having river basin areas larger than 10,000 square kilometers: the Ziqu, Angqu and the Yangbi Jiang. The entire length of the Lancang Jiang's mainstream is 4,500 kilometers, and the total drop is 5,500 meters.

The length of the Lancang Jiang inside China measures only some 2000 kilometers, but it has a 5,000-meter drop, a drainage area of 167,400 square kilometers and an annual mean flow of 1,900 cubic meters per second. Within the national boundary, its hydraulic reserves total 36.5 million kilowatts, enough to develop 144 hydropower stations. Total installed capacity would be 23.4 million kilowatts, and more than 126 billion kilowatt-hours of electricity could be generated annually.

Flowing north to south through the western part of Yunnan Province, the Lancang Jiang's water power resources are found mainly inside Yunnan Province and constitute a large hydropower base. Topographical relief and geological conditions are favorable and the water reservoir projects entail minimal inundation losses, thus making it possible to find excellent dam sites, build a number of large reservoirs to regulate runoff, and improve the river's assured output and annual power output. Hence, the economic value of developing this hydropower base is great, and the economic results will be excellent. Its shortcoming lies in the fact that it is geographically situated in the southwest, and consequently the power has to be transmitted over longer distances. As Yunnan lacks coal and petroleum resources, it will rely mainly on two hydropower bases for its power supply, the Jinsha Jiang in the north, and the Lancang Jiang in the south. The development of the Lancang Jiang's hydropower resource will play a decisive role in Yunnan's national economic growth.

According to preliminary plans, 15 cascades will be developed along the Lancang Jiang's mainstream from Liutongjiang to Nanla Hekou. They include Liutongjiang (550,000 kW), Jiabi (430,000 kW), Wunonglong (800,000 kW), Tuoba (1.64 million kW), Huangdeng (1.86 million kW), Tiemankan (1.78 million kW) Gongguoqiao (900,000 kW), Xiaowan (4 million kW), Manwan (1.5 million kW), Dachaoshan (1.3 million kW), Sijiacun (1.1 million kW), Nuozhadu (2.6 million kW), Jinghong (1.35 million kW), Ganlanba (220,000 kW), and Nan'a Hekou (700,000 kW). Total utilized head is 1,680 meters, total installed capacity is 20.73 million kW, assured output is 9.585 million kW, and the annual power generation is 108,830 billion kWh. Among these fifteen cascada hydropower stations, the installed capacity of nine stations will exceed 1 million kW, and their overall capacity can reach 17.13 million kW, accounting for 83 percent of the capacity of all fifteen cascades. Thus, the Lancang Jiang hydropower base will be a giant project mainly consisting of hydropower stations of more than 1 million kW capacity.

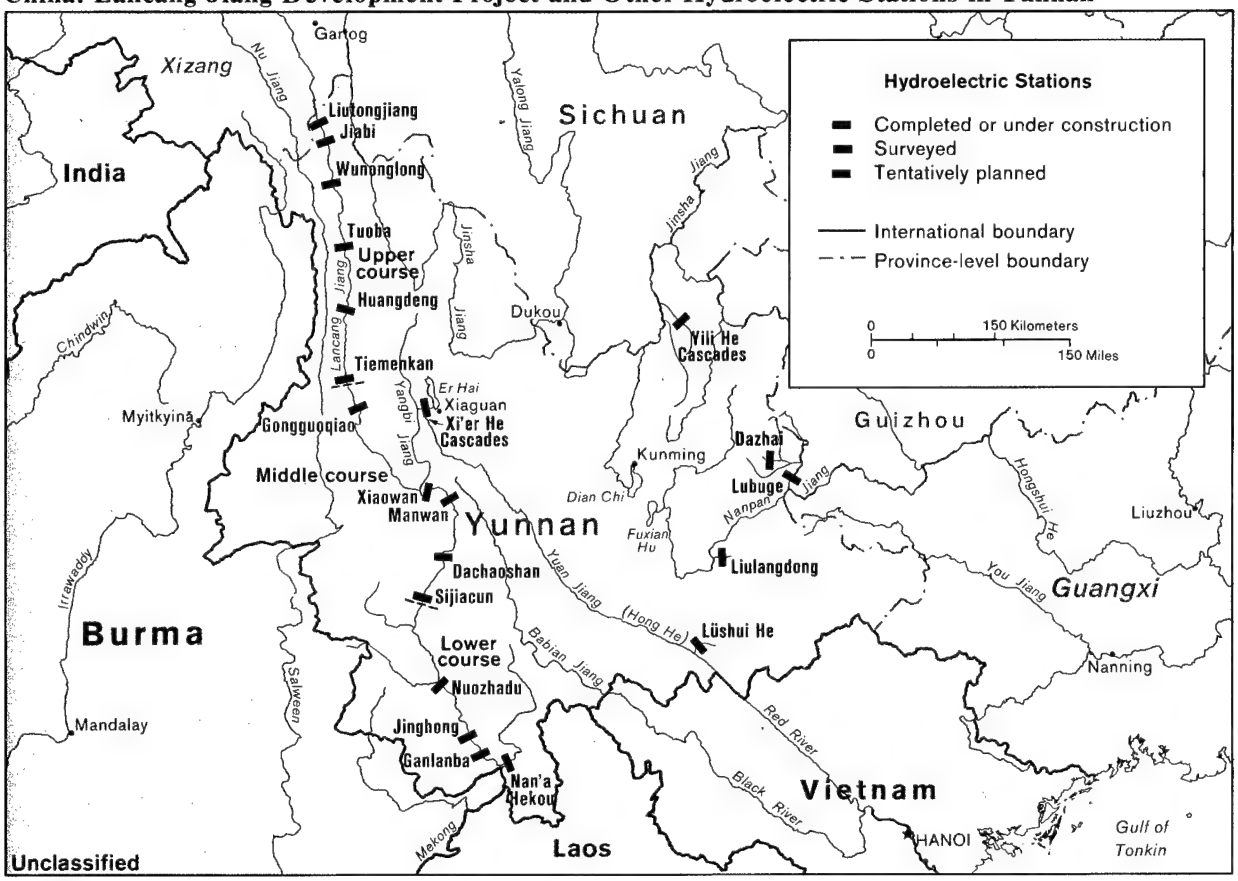
Among the Lancang Jiang's fifteen hydropower stations, nine are located on the middle and lower courses (from Gongguoqiao to Nan'a Hekou) which have good conditions for development especially those on the middle course of the river where the geographical location is suitable, geological conditions are favorable, reservoir inundation losses are minimal, traffic and communications are relatively convenient, and development is primarily for the generation of electric power.

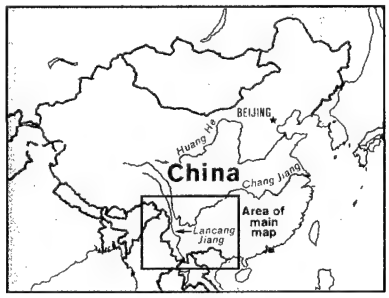
The dam of Gongguoqiao Hydropower Station will be built near Gongguoqiao in Yunlong County, Yunnan Province. Surveys for the planning phase indicate that the dam site has relatively thick overlying formations, with scant earth or sand materials in the vicinity. Prior to the development of hydropower stations upstream, Gongguoqiao's installed capacity will be 750,000 kW, assured output 154,000 kW, and annual output 3.38 billion kWh. After the upper course is developed, its installed capacity will reach 900,000 kW, assured output 418,000 kW, and annual output 4.77 billion kWh.

The dam of Xiaowan Hydropower Station will be located within the counties of Nanjian and Fengqing. Mountains on either side of the river are 1,000 meters high and the geological conditions are favorable for dam building. This is where the control dam for developing the middle course of the Lancang Jiang will be situated. The dam is 300 meters high with a reservoir capacity of 15.6 billion cubic meters. The initial installed capacity will be 3.2 million kW, assured output 1.59 million kW, and annual output 16.7 billion kWh. Moreover, it could double the assured outputs of stations downstream, boosting their installed capacities and power outputs by approximately 30 percent.

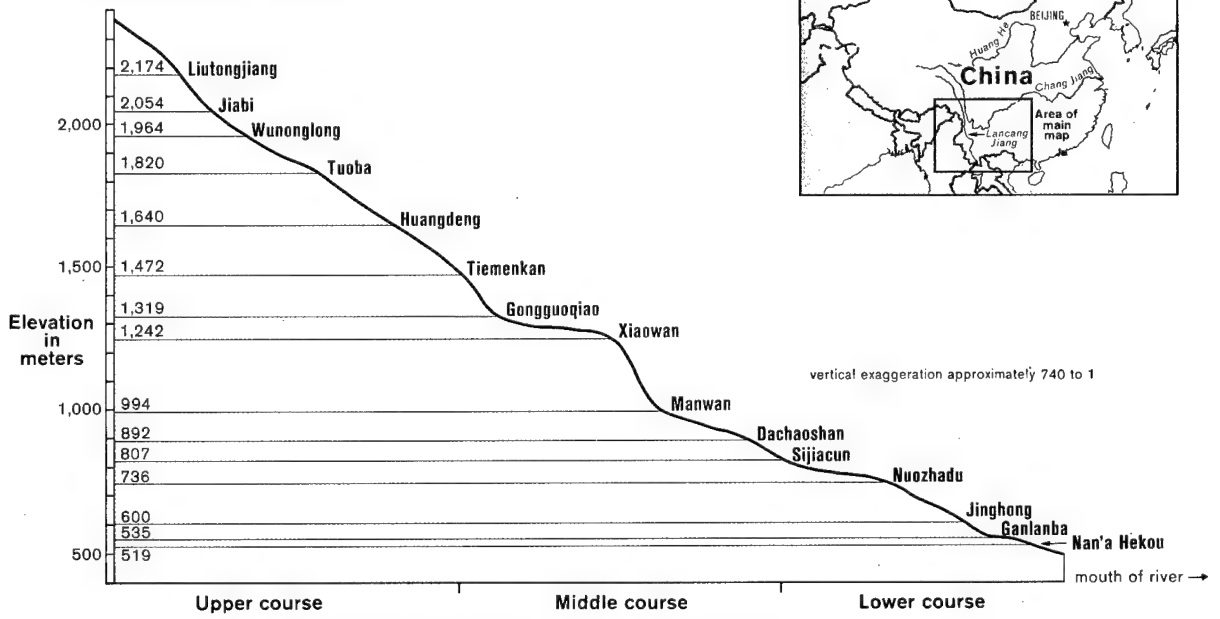
The dam of Manwan Hydropower Station is to be built in Yun Xian and it will be the first stage project on the middle course of the Lancang Jiang. The station's energy index is very promising, the dam site has excellent topographical relief and geological conditions, and the project will entail minimal engineering effort. There is open ground for the construction site, and the nearby highways provide convenient communications. Moreover, it will be possible to utilize the natural sand and rock in the vicinity, and

China: Lancang Jiang Development Project and Other Hydroelectric Stations in Yunnan





Lancang Jiang Profile



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the power transmission distance to Kunming will be relatively short. Initial installed capacity is projected at 1 million kW, assured output 330,000 kW, and annual output 5.48 billion kWh. Following the completion of the Xiaowan hydropower project, Manwan's installed capacity will go up to 1.5 million kW, assured output to 668,000 kW, and annual output to 7.13 billion kWh.

Also situated within the boundary of Yu Xian, the Dachaoshan Hydropower Station's dam will be built 1.5 km below the confluence of the Naguo He, a tributary of the Lancang Jiang. Manwan is 95 km upstream from Dachaoshan. Here, the mountains on either side of the river are of uniform height and symmetric, with peaks 600-700 meters above the water level. Rock at the dam site is igneous and seamed, but relatively hard with fairly good lithological character, and therefore suitable for building concrete dams. Due to the narrow river valley, construction traffic conditions are relatively poor. Following the completion of Xiaowan and Manwan the installed capacity of Dachaoshan Hydropower Station will be 1.3 million kW, assured output 630,000 kW, and annual output 6.87 billion kWh.

Sijiacun Hydropower Station's dam is to be situated in Lincang County, Yunnan Province. Due to the metamorphic arenaceous rock formations, the dam site has poor geological conditions. But there are highways passing through, thus facilitating access to the outside. On completion of Xiaowan and Manwan, its installed capacity will be 1.1 million kW, assured output 510,000 kW, and annual output 5.73 billion kWh.

Nuozhadu Hydropower Station's dam will be located on the border of Pu'er and Lancang Counties, on the lower course of the Weiyuan Jiang, a tributary of the Lancang Jiang. It has a regulatory reservoir capacity of 7.3 billion cubic meters, the second largest regulatory reservoir after Xiaowan Hydropower Station. To a certain extent, by regulating the discharge, it will help to improve the assured output and annual power output of the cascade stations downstream. The rock formation in the dam site is quite hard; the bed is exposed at the surface, the mantle rock layers are relatively thin, and the geological conditions are relatively favorable. On completion of the Xiaowan and Manwan stations, its installed capacity will be 2.6 million kW, assured output 1.28 million kW, and annual output 13.95 billion kWh. It is the second largest hydro project in the hydropower base, following Xiaowan.

Besides the cascade power stations at Xi'er (on completion, the installed capacity of all four cascades will be 250,000 kW) on the upper course of the Yangbi Jiang, the mainstream of the hydropower base has not been developed or utilized. A report on the planning phase of the Lancang Jiang's middle course was completed in 1980; the initial design of Manwan Hydropower Station will be completed in 1983 or the first half of 1984. A great deal of surveying work has been done at the Xiaowan site. Surveys for the planning phase of Gongguoqiao were done in the 1950's, and similar surveys are currently underway at the Dachaoshan, Sijiacun, and Nuozhadu sites.

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CSO: 4013/289

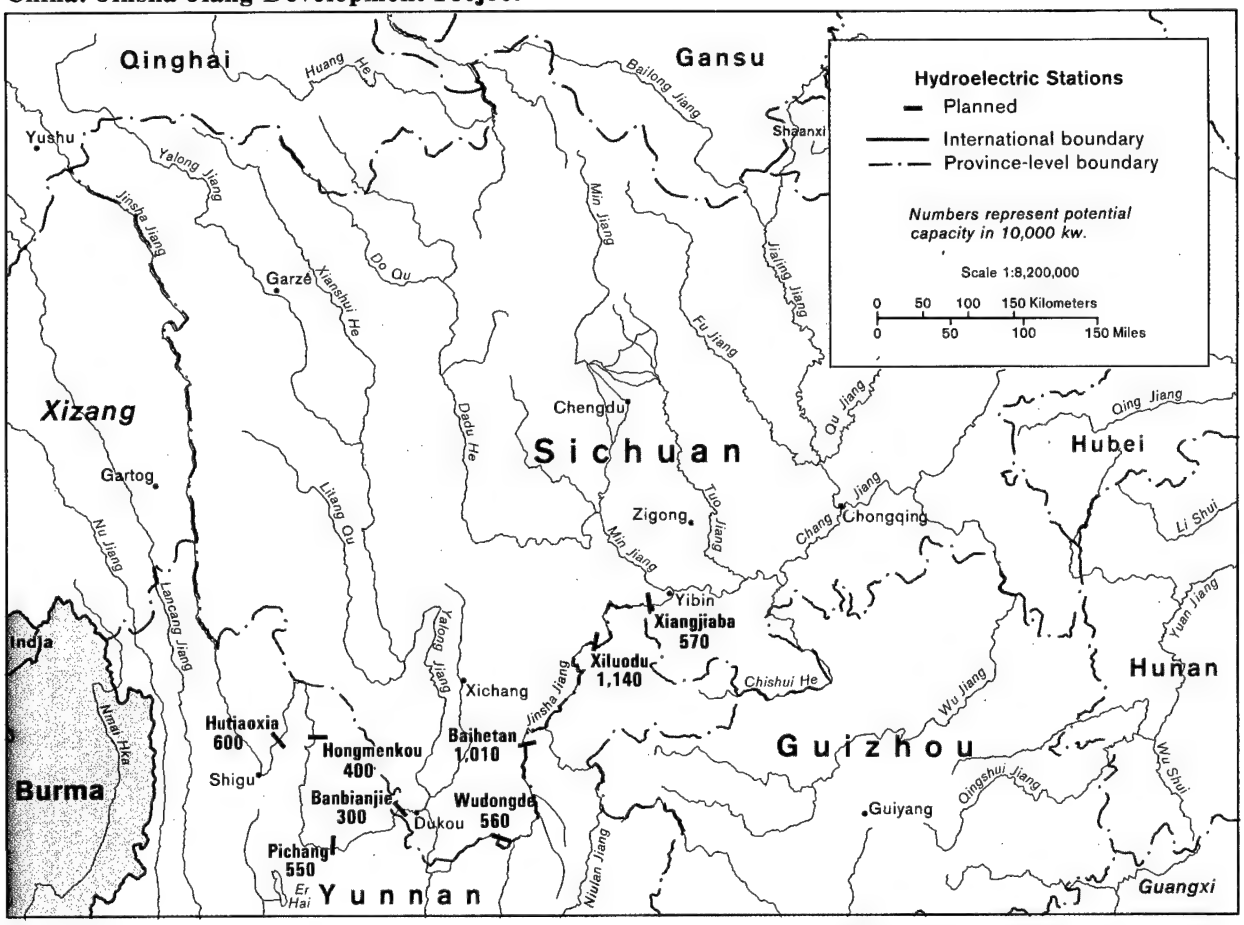
THE JINSHA JIANG HYDROELECTRIC POWER BASE

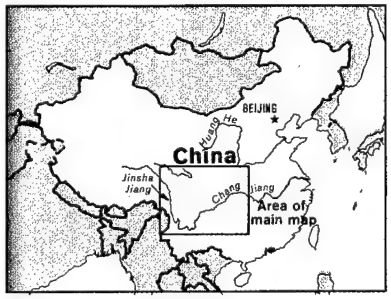
Beijing SHUILI FADIAN [WATER POWER] in Chinese No 6, 12 Jun 83 pp 15, 46

[Text] The upper section of the Chang Jiang between Yushu in Qinghai and Yibin in Sichuan, with a length of 2,300 km, is called the Jinsha Jiang. The valley above Yibin has an area of 473,000 km^2, the multiyear average discharge is 4,610 m^3/sec, and the multiyear average volume is 145.6 billion m^3, 3 times that of the Huang He. This section of the river drops 3,300 meters, or 60 percent of the total drop of the Chang Jiang. Developable hydropower resources on the main stream above Yibin total 58.91 million kW, equivalent to an annual generating capacity of 323.3 billion kWh. Because of the large water volume, the concentrated drop in elevation, the small inundation loss, and the excellent energy indicators, it is one of China's richest hydropower bonanzas, and China's largest hydropower base. Developing the Jinsha Jiang not only will make up for the southwest's lack of coal and satisfy the area's steadily increasing electric power needs, but in addition will allow eastward transmission to central and east China of this western-generated electricity. In addition, it can improve navigation, timber transport and irrigation and make it possible to control some of the Jinsha Jiang's flood waters, thus taking on some of the middle Chang Jiang flood reduction tasks. The main problems are that many of the dam sites are located in gorges deep in the mountains, the geology of the area is complex, earthquake intensity is high, transport is difficult, the amount of underground engineering required is large, there is limited room for construction operations, and the construction tasks are rather arduous.

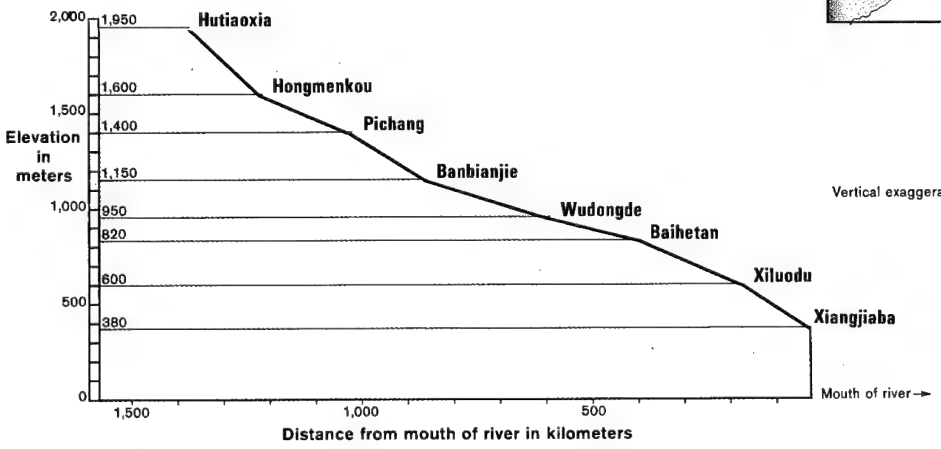
Development will focus on the section between Shigu in Yunnan and Yibin in Sichuan, which will be divided into eight stages: Longtiaoxia (6 million kW), Hongmenkou (4 million kW), Pichang (5.5 million kW), Banbianjie (3 million kW), Wudongde (5.6 million kW), Baihetan (10.1 million kW), Xiluodu (11.4 million kW), and Xiangjiaba (5.7 million kW). This section of the river will have a total installed capacity of 51.3 million kW, with a guaranteed output of 26 million kW, and an annual energy output of 287.0 billion kWh. The inundation loss for these eight stations will be very small, and the number of people resettled as a result will be only about the same as for the Xin'an Jiang Hydroelectric Station. Relatively large amounts of survey and design work have been done for the stations at Longtiaoxia, Baihetan, Xiluodu and Xiangjiaba.

China: Jinsha Jiang Development Project





Jinsha Jiang Profile



Longtianxia is in Lijiang County, Yunnan, and its installed capacity will be 6 million kW. The gorge is 17 km long and has a drop of 21 meters, the most concentrated drop on the main stream. It is possible to build a high dam at the upper gorge with a large reservoir capacity, and the construction of this station not only will produce large amounts of electric power but in addition will increase the assured output of the stations below it in the cascade by 7 million kW.

Baihetan is in Ningnan County, Sichuan, and Qiaojia County, Yunnan; the installed capacity will be 10.1 million kW, with an annual output of 55.2 billion kWh, so that it will be the main cascade level on the river. It is suitable for construction of a high dam. The reservoir capacity will be rather large and the dam will be rather effective in controlling flood waters on the river and increasing the performance of the stations below it.

Xiluodu is located in Leibo County, Sichuan and Yongshan County, Yunnan and will have an installed capacity of 11.4 million kW. Its reservoir capacity is large and it will be rather effective in generating power and controlling flood waters. The inundation loss will be small, and the geological conditions are suitable for building a high dam.

The Xiangjiaba station will be located in Bingshan County, Sichuan, 35 km above Yibin. It is the last station in the cascade above Yibin. Its installed capacity will be 5.7 million kW. It is located in the energy-use center of Sichuan, and water and land transport is convenient. It can be used to develop natural-flow irrigation of about 3 million mu of land and will improve navigation conditions, but the geological conditions are rather complex.

Since 1958 the Chang Jiang Valley Planning Office, the Chengdu Survey and Design Academy, the Kunming Survey and Design Academy and the Sichuan Geological Bureau have carried out planning-stage geological mapping and exploration work at the main dam sites in this section of the river and have drafted a preliminary cascade development program. Now the Ministry of Water Resources and Electric Power's Chengdu and Kunming survey and design academies and the Chang Jiang Valley Planning Office are conducting joint planning work. In the future they will carry out further effective planning, design and scientific research work for the Longtiaoxia, Baihetan, Xiluodu and Xiangjiaba stations and create the conditions for development of the Jinxia Jiang.

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CSO: 4013/262

THE YALONG JIANG HYDROELECTRIC POWER BASE

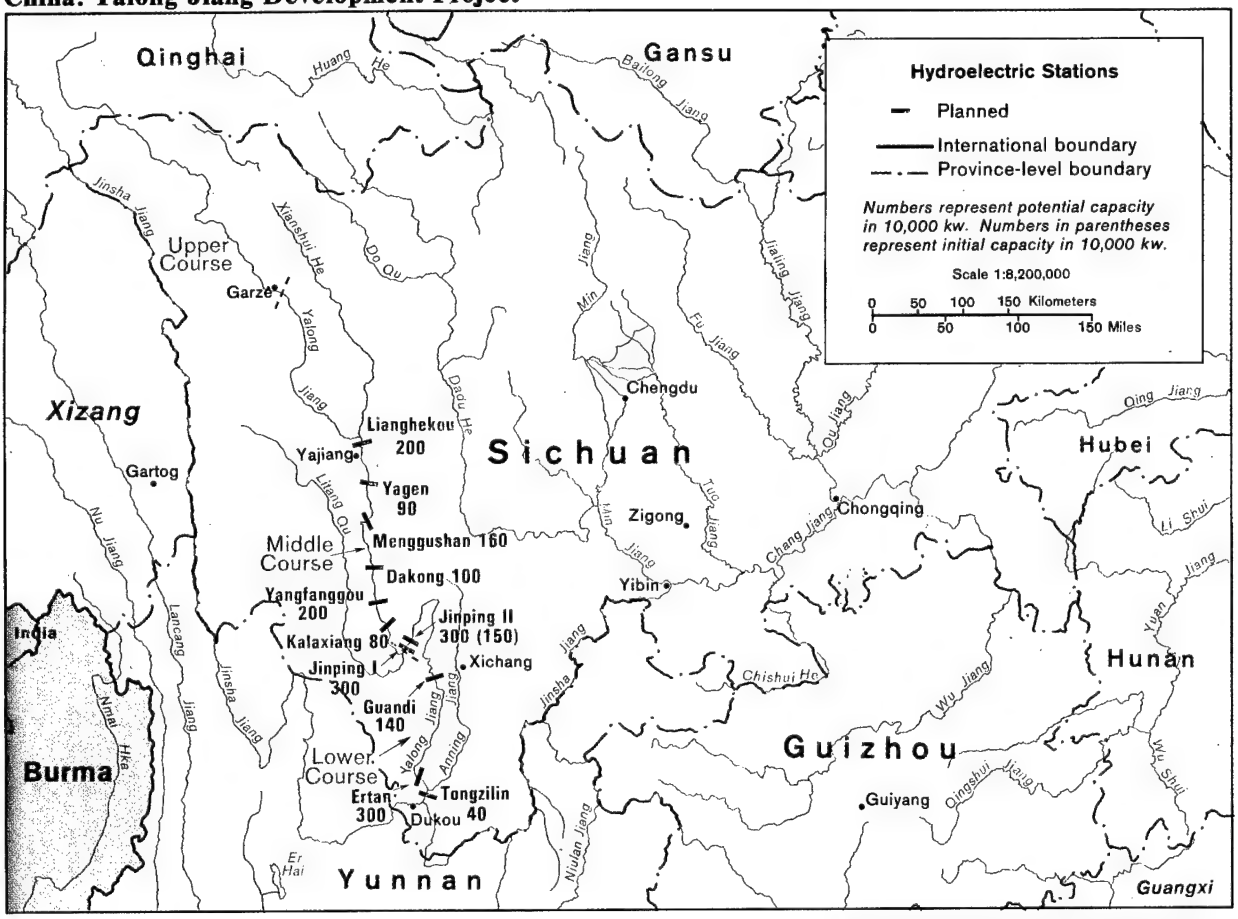
Beijing SHUILI FADIAN [WATER POWER] in Chinese No 4, 12 Apr 83 pp 11-12

[Text] The Yalong Jiang is the largest tributary of the Jinsha Jiang on the upper reaches of the Chang Jiang. It originates on the southern slopes of the Bayan Har Shan in Qinghai Province, flows southward through the western part of Sichuan Province, and enters the Jinsha Jiang at Dukou city. The Yalong Jiang River Valley covers an area of 130,000 square kilometers and the average annual flow at the river mouth is 1,870 m^3/sec. The annual runoff is 59.1 billion cubic meters, or 13.3 percent of the runoff of the Chang Jiang in its upper reaches. The theoretical hydraulic power reserve of the entire river valley is 33.72 million kilowatts, or 5 percent of the total water power reserve in China, out of which 24.94 million kW may be developed with a resulting annual energy production of 152.5 billion kWh, or 8 percent of the total national hydropower production.

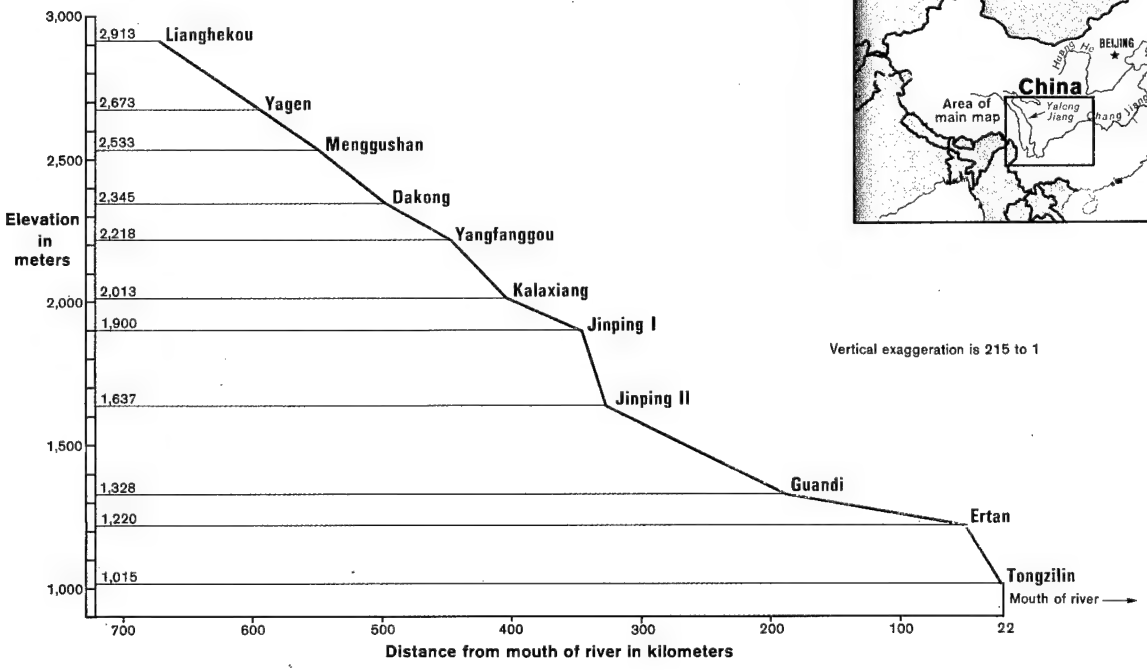
The Yalong Jiang River Valley is located southeast of the Qing-Zang Plateau and is surrounded to the north, west, and east by high mountains and plateaus in the 4,000-5,000 meter elevation range. The elevation gradually decreases in the south to 980 meters above sea level at the river mouth. The elevation difference of the river is as much as 4,000 meters. The section above Garze is called the upper course, where wide plains and valleys alternate with deep gorges and the water power reserve is rich. The middle course extends from Ganzi to Dahewan (Jinping), where the river flows through high mountains and canyons. Below Dahewan is the lower course where the terrain is again mountainous canyon, the water resources very rich and the drop very concentrated.

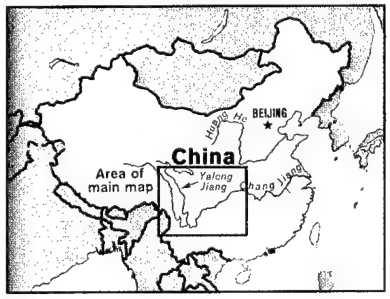
The length of the Yalong Jiang is 1,571 kilometers, the natural drop is 3,870 meters, and the water power reserve is 22.04 million kW, of which 18.13 million kW are in the section between Lianghekou and Dukou. The average water power reserve per kilometer of river is 20,000 to 30,000 kW, or 11,000 kW per meter of drop. The principal goal for developing the Yalong Jiang is to generate electric power. The lower course, with a water power reserve of 19 million kW, is located close to the industrial areas in Dukou and Xichang and is 300 kilometers from Chengdu and 400 kilometers from Chongqing in straight-line distance. Conditions for development are superior.

China: Yalong Jiang Development Project



Yalong Jiang Profile





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In developing the Yalong Jiang, priority has been placed on the middle and lower courses from Lianghekou to Dukou where the flow is abundant, the drops are concentrated, the severity of earthquakes low, and the geological and transportation conditions both good. Preliminary plans call for 11 cascades: Lianghekou (2 million kW), Yagen (900,000 kW), Menggushan (1.6 million kW), Dakong (1 million kW), Yangfanggou (2 million kW), Kalaxiang (800,000 kW), Jinping I (3 million kW), Jinping II (3 million kW; 1.5 million kW before the completion of Jinping I), Guandi (1.4 million kW), Ertan (3 million kW), and Tongzilin (400,000 kW).

These 11 cascades make use of a head drop of 1,900 meters. The total generator capacity is 19.1 million kW, the assured output is 8.22 million kW, and the annual power production will be 113 billion kWh, or 74.1 percent of the exploitable water power of the entire Yalong Jiang River Valley. The Yalong Jiang is a river on which large hydroelectric power stations may be relatively concentrated. Of the 11 cascade hydropower stations, 8 have capacities greater than 1 million kW and 4 have capacities greater than 2 million kW. The reservoirs at Lianghekou and Jinping I, which control incoming water from the two largest branches on the middle and lower courses, are the largest regulatory reservoirs on the Yalong Jiang. The reservoir at the Ertan station has a capacity of 5.8 billion cubic meters and is the third largest reservoir on the river. Extensive survey and design work has been conducted for the river section below Jinping I, especially for the Ertan station. Studies have shown that the rock at the dam base of Ertan is hard, the riverbed covering is 20-40 meters, the local geological structure is stable, flooding loss is low, the dynamic economic index is high, and the development plan and the construction conditions are clear-cut. All these make Ertan one of the most favorable hydropower projects on a major river in the southwest.

The reservoir at Jinping I is a control reservoir on the lower course of the Yalong Jiang. Located downstream from the convergence of the Litang Qu, the largest tributary of the Yalong Jiang, the river canyon is narrow at the dam site and the rock is hard enough to build a high dam. At a water level of 265 meters, the reservoir holds 10 billion cubic meters of water with an effective reservoir capacity of 6 billion cubic meters and incomplete yearly regulation can be achieved. The generator capacity is 3 million kW, the assured output is 1.45 million kW and the yearly power production is 18.2 billion kWh. However, the dam will be as high as 280-300 meters, which makes this a complex and large engineering project to be carried out under poor transportation and construction conditions.

The Jinping II station will make use of the big bend in the river and water will be directed through a 16-kilometer tunnel to achieve a head drop of 309 meters. The generation capacity will be 3 million kW, the assured output 1.9 million kW, and the annual power production will be 21 billion kWh. Before the Jinping I station is completed, the first phase of the Jinping II project will draw 650 cubic meters per second, the generator capacity will be 1.5 million kW, the assured output will be 760,000 kW and the annual power generation will be 11.4 billion kWh.

The Ertan hydroelectric station is located near Dukou city, 18 kilometers from the Tongzilin station on the Chengdu-Kunming Railroad. There is existing highway access and the transportation and construction conditions are both good. The dam foundation consists of hard syenite, the riverbed cover is 30 meters thick, the earthquake severity is 7, the geological conditions are favorable for constructing a high dam. The reservoir capacity is large and the loss to flooding will be small. The hydropower station will be 3 million kW with an annual output of 18 billion kWh. When operated alone, the generator capacity is 3 million kW, the assured output is 1.02 million kW and the yearly electricity generation will be 16.8 billion kWh.

The Tongzilin project is located near the Tongzilin station on the Chengdu-Kunming Railroad, 22 kilometers from Dukou. Transportation and construction conditions are both good. A low dam will be built to hold 25 meters of water and a 400,000 kW generator will be installed. The assured output is 100,000 to 230,000 kW and the annual electricity production will be 2.1 to 2.5 billion kWh. The geological conditions of the Tongzilin power station, however, are rather complicated and further studies should be made.

The Yalong Jiang has good potential for hydropower development but the construction of hydroelectric stations on its main stream has not yet begun. To date, only a medium-sized hydropower station (37,500 kW) has been built on the Mofanggou branch, along with a dozen or so small hydro stations. Some survey and design work has been done for the middle and lower courses of the Yalong Jiang and the feasibility studies for Ertan and Tongzilin will be completed some time in 1983. Preliminary design has been made for the first phase of the Jinping II station but some supplemental work still needs to be done. The Ertan project has a good potential to become a major energy source and relatively extensive survey and design work is being conducted; a high priority has been given to the development of this station. The first phase of the Jinping II project has a large assured output and superior economic conditions. It is an unusually good hydroelectric source, but construction and transportation are difficult. The emphasis today should be on the improvement of transportation and the completion of the survey and design work so that Jinping II may be developed after the completion of the Ertan station. The Yalong Jiang hydroelectric base should be completed as soon as possible because it would not only satisfy the electric power needs of the nearby Dukou and Xichang area but it would also supply power to the industrial regions in Chengdu and Chongqing by transmitting the power generated from western to eastern China.

9698
CSO: 4013/223

THE DADU HE HYDROELECTRIC POWER BASE

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 5, 12 May 83 pp 7-9

[Text] The Dadu He is the largest tributary of the Min Jiang. It originates in the Golog Mountains, Qinghai Province, and enters the Min Jiang at Leshan city; it is a second class tributary on the upper course of the Chang Jiang. The length of the Dadu He is 1,062 kilometers and its valley area is 77,400 square kilometers (not including the Qingyi Jiang), and its water energy reserve is theoretically 31 million kilowatts. Surrounded by rugged mountains, the Dadu He River Valley is a southeastern extension of the Qinghai-Xizang Plateau. At the source of the river above Shuangjiangkou, wide plateau valley and mountain canyon are about half and half. The valley is generally narrow in the mountainous zone between Shuangjiangkou and Tongjiezi, becoming wider only between Shimian and Fulin. The section between Tongjiezi and the mouth of the river is a hilly area with a wide valley. Hydraulic resources are mainly in the Shuangjiangkou-to-Tongjiezi section which is 600 kilometers in length and has a natural drop of 1,800 meters. This section has 17.48 million kW of reserves, or 30,000 kW of hydraulic energy per kilometer of river and almost 10,000 kW per meter of drop.

The Dadu He has a stable and abundant flow. The hydrological station on the main run at Tongjiezi has been recording an average flow rate of 1,500 m^3/sec for many years. The average annual flow has been 50 billion cubic meters, comparable to the flow of the Huang He. The Dadu He has very small flood loss and is located close to the major industrial and agricultural areas in central Sichuan. The distance for power transmission is 160-240 kilometers to Chengdu and 285-500 kilometers to Chongqing. Highway access is available to all the major dam sites below Shuangjiangkou except for the 90 kilometers from Danba to Luding. From Pubugou, convenient transportation is provided by railroad along the river or in the vicinity. The development of the Dadu He is mainly for hydropower production and the secondary objective is log transportation. The main problem is the complex geological structure in this area; most of the riverbed covering is thick and the earthquake severity is also high.

The preliminary development plan calls for 17 cascades on the main run between Shuangjiangkou and Tongjiezi. The downstream order is: Dusong (1.4 million kW), Ma'nai (300,000 kW), Jijiaheba (2.2 million kW),

Houziyan (1.4 million kW), Changheba (1.24 million kW), Lengzhuguan (900,000 kW), Luding (600,000 kW), Yingliangbao (1.1 milliqn kW), Dagangshan (1.62 million kW), Longtoushi (500,000 kW), Laoyingyan (500,000 kW), Zaiyangxi (400,000 kW), Pubugou (800,000 kW), Shenxigou (340,000 kW), Zhentouba (420,000 kW), Gongzui (700,000 kW, the original design aimed at an ultimate capacity of 2.1 million kW; a low dam with a capacity of 700,000 kW has been completed), and Tongjiezi (600,000 kW). The total drop is 1,699 meters, the total generator capacity is 16.42 million kW, the assured output is 7 million kW and the annual power production is 95 billion kWh. Seven hydropower stations among the 17 cascades have capacities greater than 1 million kW.

Dusong's total reservoir capacity is 5 billion cubic meters, the dam zone is granite and the maximum thickness of the riverbed cover is 78 meters. The generator capacity is 1.4 million kW, the assured output is 540,000 kW and the annual power generation is 7.1 billion kWh.

Dagangshan is one of the better power stations on this section of the river. The generator capacity is 1.6 million kW, the assured output is 750,000 kW in cascaded operation, and the annual production is 9.8 billion kWh. Flooding loss in the reservoir zone is small, preliminary studies showing only 375 mu to be flooded and 215 people to be displaced. The riverbed cover is thin but the earthquake intensity is high. The geological structure in this region is also complex.

Pubugou is located in Hanyuan County, Sichuan Province. A highway runs through the dam site and the distance to Wusihe Station on the Chengdu-Kunming Railroad is only 8 kilometers. The generator capacity is 800,000 kW, the assured output in cascaded operation is 390,000 kW and the annual power production is 5.3 billion kWh.

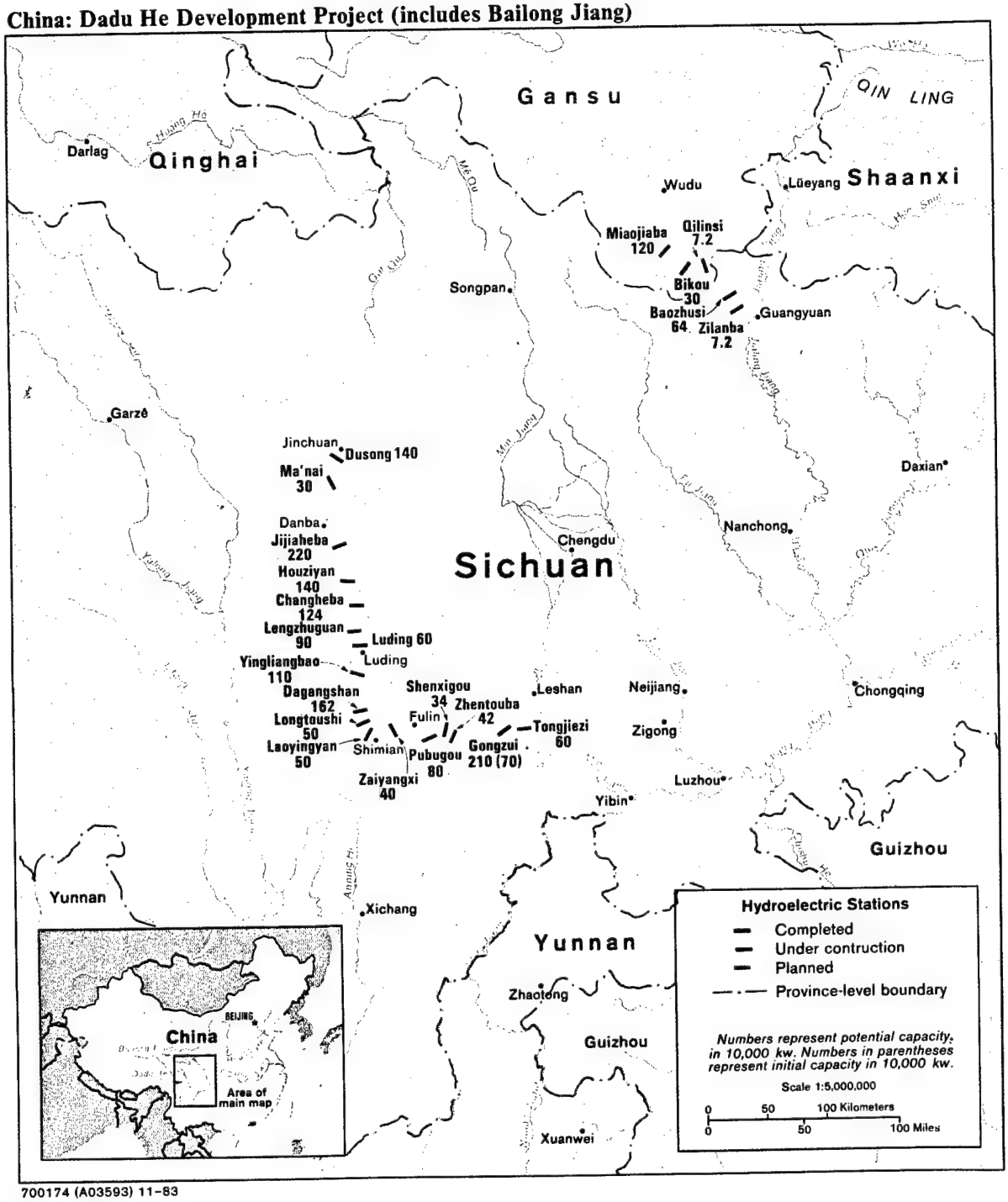
Tongjiezi is the last cascade on this section. It is located in Leshan County, Sichuan. The generator capacity is 600,000 kW, the assured output is 130,000 kW in independent operation, and the annual power production is 3.2 billion kWh. When operated in cascade, the assured output is 240,000 kW and the annual power production is 3.3 billion kWh. The reverse regulatory function of the Tongjiezi station may resolve shipping limitations below the completed Gongzui station.

In addition, the Nanya He, a branch of the Dadu He, has a usable drop of 1,700 meters and may be developed in 7 cascades with a total generation capacity of 579,000 kW. When the Yele multi-year regulatory reservoir is built on the upper reaches, there will be the possibility of enlarging the capacity to 800,000 to 1 million kW in the future.

The Jialing Jiang Branch of the Bailong Jiang system:

The Jialing Jiang originates in Qinling in Shaanxi Province and flows through Gansu and Sichuan before joining the Chang Jiang at Chongqing. The Bailong Jiang is rich in hydraulic resources. The section from Wudu to the mouth of the river on the lower course features convenient transportation

China: Dadu He Development Project (includes Bailong Jiang)



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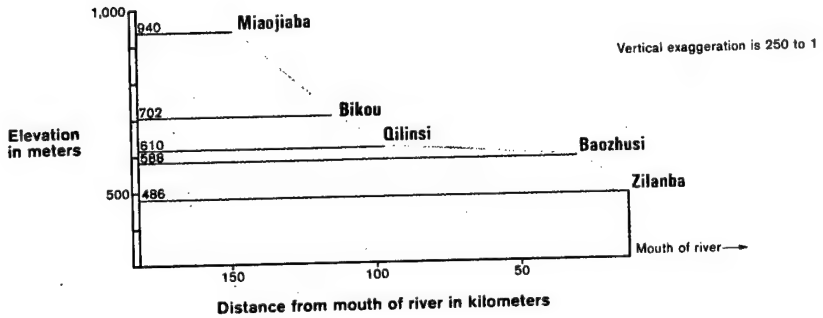
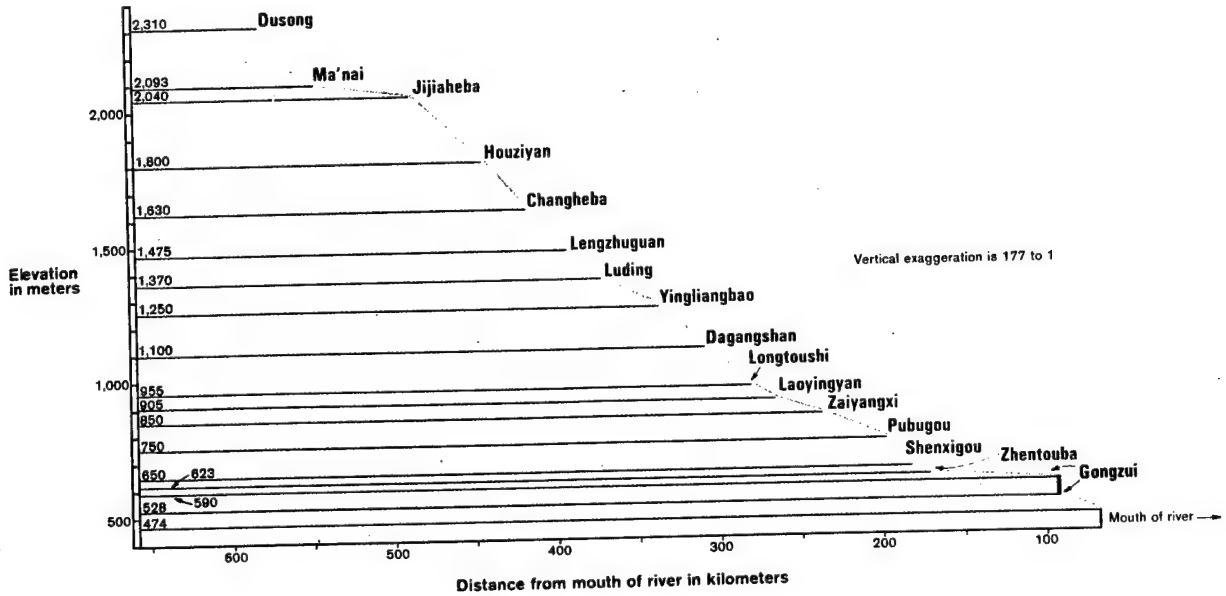
Bailong Jiang Profile



Dadu He Profile



20-B

and good potential for development. According to a five-cascade development scheme, the power stations will be at (from top to bottom): Miaojiaba (1.2 million kW), Bikou (300,000 kW), Qilinsi (72,000 kW), Baozhusi (640,000 kW), and Zilanba (72,000 kW). The total generating capacity of this section of the river will be 2.28 million kW. Miaojiaba, Bikou, and Baozhusi have the best potential.

Miaojiaba is located 35 kilometers upstream from Bikou zhen in Wen County, Gansu Province, the dam site is located 30 kilometers and 20 kilometers respectively from the Gansu-Sichuan Highway up and down the river. When the Bikou reservoir is filled to the normal high water level, vessels may reach the dam site directly. The primary development objectives are power generation and log transport. The Miaojiaba reservoir will play a control role for the middle reaches of the Bailong Jiang, at the normal level of 940 meters, the main reservoir has a capacity of 3.6 billion cubic meters and multi-year regulation may be achieved. It is the best reservoir in this region in terms of performance. Taking water from Baishui Jiang, the generation capacity is 1.2 million kW, the assured output is 360,000 kW, and the annual power generation is 3.6 billion kWh.

Baozhusi is located in Guangyuan County, Sichuan Province. It is 87 kilometers downstream from Bikou and 18 kilometers from Zhaohua Station on the Bao-Cheng Railroad downstream. The Gansu-Sichuan Highway passes through the dam site on the right bank and provides convenient transportation. The primary goal for developing the Baozhusi station is power generation, augmented by irrigation, industrial water supply, shipping and log transport. The generating capacity is 640,000 kW, the assured output is 160,000 kW, and the annual power production will be 2.2 billion kWh. The reservoir at the Baozhusi station has a large capacity and partial year regulation can be achieved. Since most of the hydropower stations already built in Sichuan are rather poor in terms of regulation ability, the amount of seasonal electric power is great but cannot satisfy the need for a balanced year-round power supply. The construction of the Baozhusi hydropower station will have a compensatory and regulatory effect on the power stations already built in this river valley and in other river valleys in providing more power during the low water season.

As of now, the only hydropower station already completed on the Dadu He is the Gongzui station (low dam) with a generator capacity of 700,000 kW, an assured output of 180,000 kW, and an annual production of 3.4 billion kWh. Construction of the 600,000 kW Tongjiezi station on the lower course has already begun. A second (14,500 kW) cascade power station on the Nanya He has been completed, and a third (120,000 kW) station is under construction. The 300,000 kW Bikou hydropower station on the Bailong Jiang has been completed. Planning for the Shuangjiangkou-to-Tongjiezi section of the Dadu He is underway. Extensive surveying has been done for Dagangshan and survey work on Longtoushi is in progress. The preliminary design for the Baizhusi Station on the Bailong Jiang has now been completed and construction work may begin shortly.

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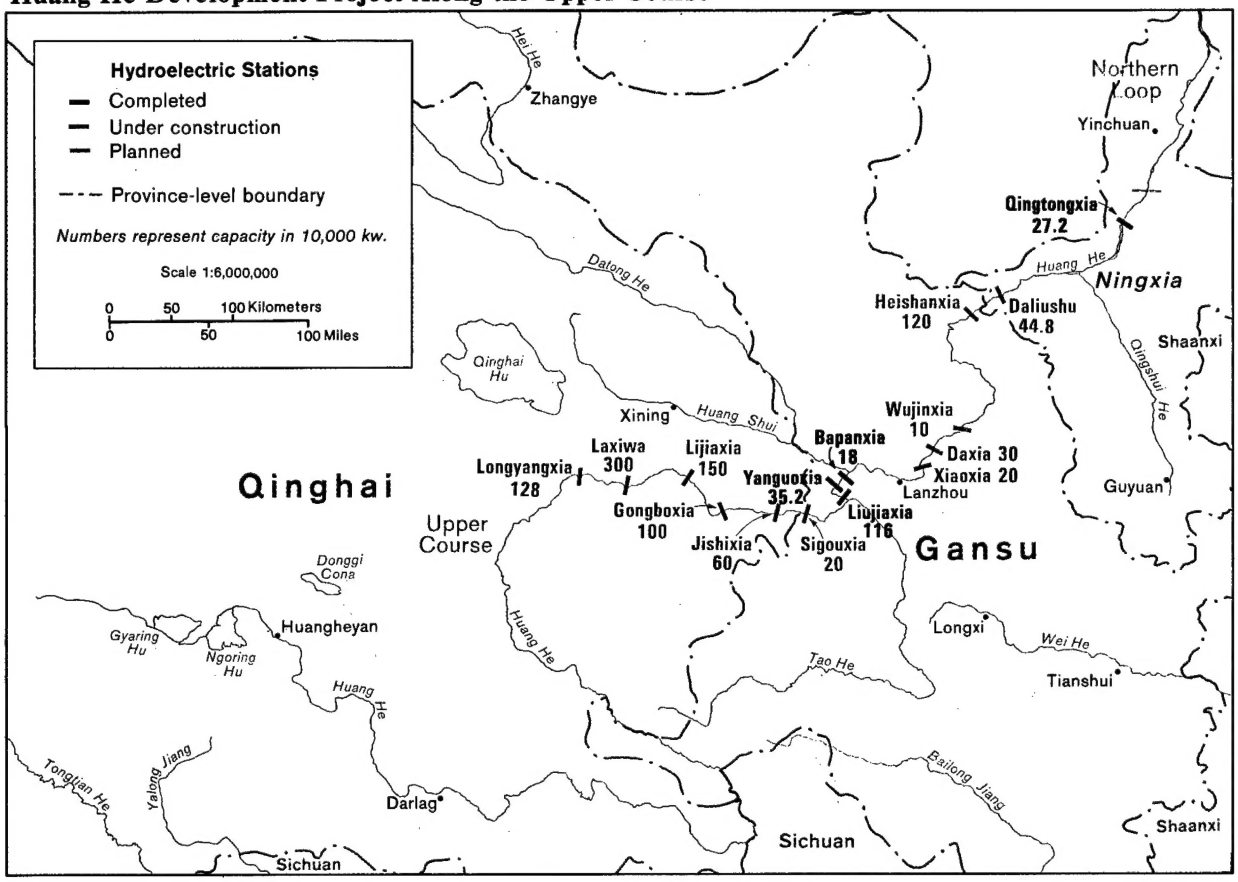
THE UPPER AND MIDDLE HUANG HE HYDROELECTRIC POWER BASE

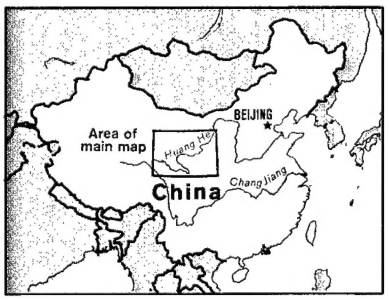
Beijing SHUILI FADIAN [WATER POWER] in Chinese No 1, 12 Jan 83 p 6-8

[Excerpts] The upper section of the Huang He between Longyangxia and Qingtongxia is rich in hydraulic resources. This section is 918 km long. The river region above Longyangxia has an area of more than 131,000 km^2, and the region below an area of 275,000 km^2. Within this section there are deep gorges, narrow river channels, and plenty of rapids. With the large drops in elevation, sparse population, and lack of tillable land, there are many good dam sites in the region. The natural drop in elevation over this section is 1,324 m, the average flow rate through Longyangxia is 640 m^3/sec, and the flow rate through Qingtongxia is 1,050 m^3/sec. Although the main purpose of developing this section is power generation, other benefits such as flood prevention, ice prevention, and fish breeding can also be realized. The advantages of utilizing the water sources of this section are: high power generation efficiency, highly reliable power supply, small amount of construction labor, relatively small investment, small amount of wasted land due to flooding, good geological conditions, and many sites suitable for building tall dams. The disadvantage is that most power stations are located in mountainous, and high-elevation regions, which makes transportation and construction very difficult.

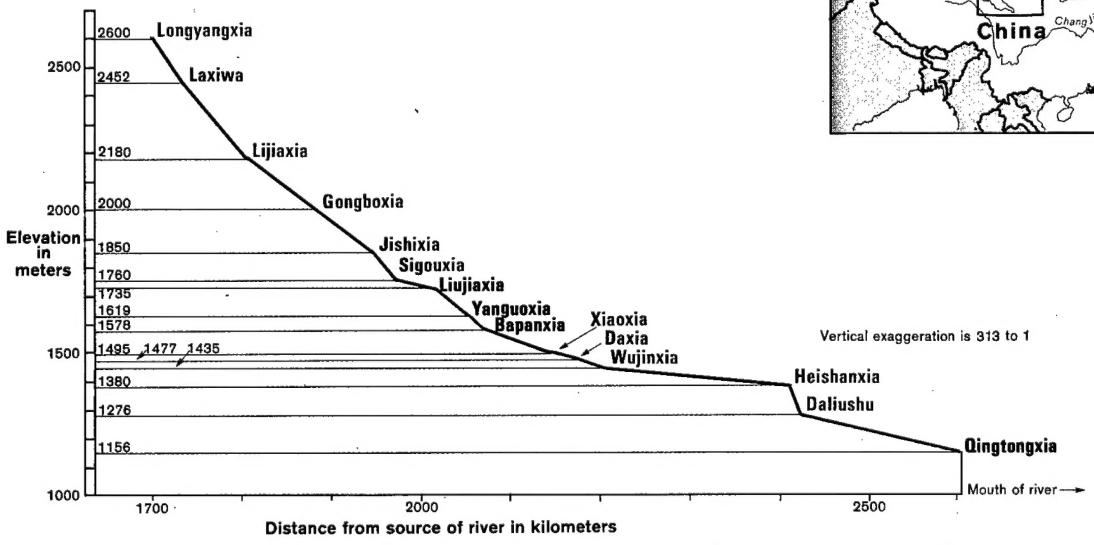
In order to fully utilize the elevation drop of the gorge section, and to avoid flooding the populated regions along the river, the tentative plan calls for the development plan of 14-15 cascades. The names of the power stations at these cascades are: Longyangxia, Laxiwa, Lijiaxia, Gongboxia, Jishixia, Sigouxia, Liujiaxia, Yanguoxia, Bapanxia, Xiaoxia, Daxia, Wujinxia, Heishanxia, Daliushu, and Qingtongxia. Whether Heishanxia and Daliushu will be developed as two cascades or combined into one as Daliushu is still being studied. The total hydraulic head of these 15 cascade power stations is 1,074 m, or 81 percent of the natural elevation drop; the total generator capacity is 11.79 million kw, and the annual amount of electricity output is 51 billion kilowatt-hours. The largest power station on this river section is the Laxiwa station, which has a generating capacity of 3 million kw, and an annual electricity output of 10.4 billion kilowatt-hours. The three large reservoirs--Longyangxia, Liujiaxia, and Heishanxia--are located respectively at the head, the midpoint, and the tail of this section. Because of their favorable geographical locations, they play an important role in regulating the narrow course of the upper reaches of the Huang He,

Huang He Development Project Along the Upper Course



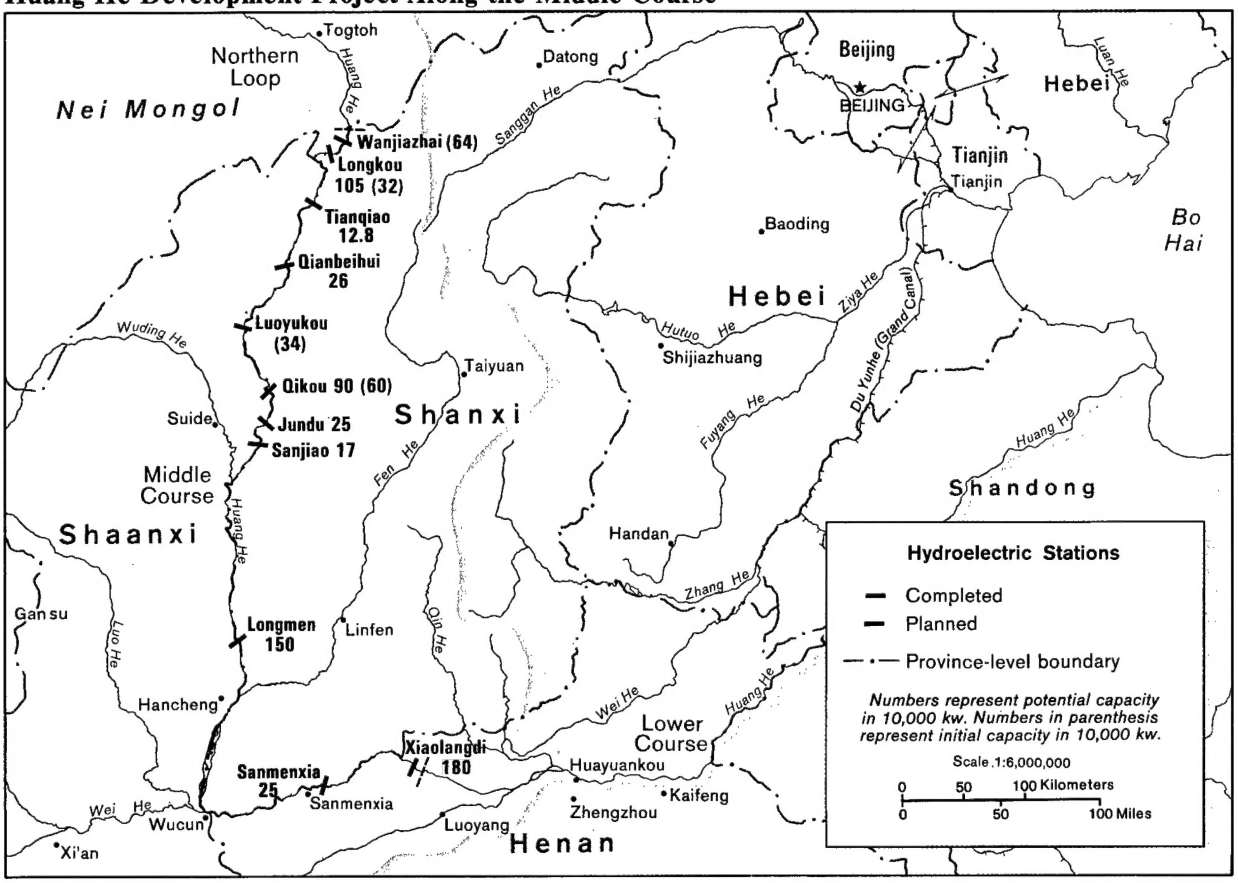


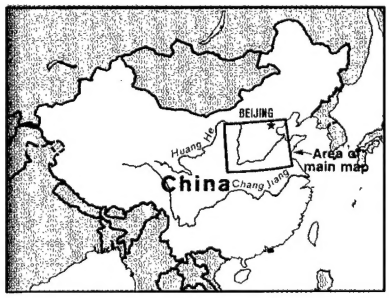
Huang He Profile



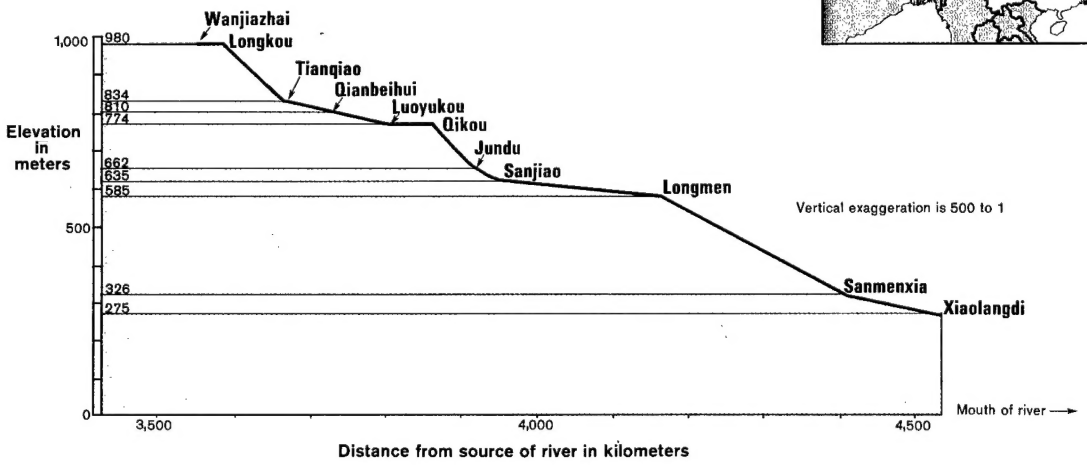
22-A

Huang He Development Project Along the Middle Course





Huang He Profile



in improving the quality of electric energy, and in providing water for irrigation and daily consumption.

At present, four hydropower stations located along the upper reaches of the Huang He -- Liujiaxia, Yanguoxia, Bapanxia, and Qingtongxia--have been completed; they have a total generating capacity of 1.96 million kw, a guaranteed production of 950,000 kw, and an annual power output of 10.1 billion kilowatt-hours. The Longyangxia power station, located at the head of the river section, is currently under construction. Upon completion it not only will add 1.28 million kw of power output and 6 billion kilowatt-hours of electricity, but also will raise the guaranteed production of the four completed power stations downstream by 500,000 kw, and increase the amount of electricity by 440 million kilowatt-hours. Its regulated reservoir will increase the amount of water for irrigation by 1.8 billion m^3, and the amount of water supply to industries and cities by 0.46 billion m^3; it will also improve the standards of flood prevention of the Liujiaxia power station and the Huang He's upstream channels. In addition, construction of the Longyangxia station will eliminate the flood peaks, reduce the amount of diversion flow for the newly constructed power stations downstream, and reduce the requirement for permanent flood-relief structures. It also provides favorable conditions in terms of reduction of construction time, labor and investment for the development of multi-million kw power stations such as Laxiwa, Lijiaxia, Gongboxia, and Heishanxia (or Daliushu). Currently, preliminary design work of the Heishanxia (or Daliushu), Lijiaxia, and Daxia stations is in progress and surveys of the Laxiwa, Gongboxia, and Jishixia stations have also begun.

The middle section of the Huang He between Tuoketuo and Huayuankou is also rich in water power resources; it is the second section of the Huang He with concentrated elevation steps and development potential. The section is 1,222 km long, with an elevation drop of 893 m. The gorge section between Wanjiazhai and Longmen is 593 km, with an elevation drop of 512 m; the section between Longmen and Tongguan is a section of meandering river; below Tongguan is a backwater region for the Sanmenxia reservoir; and the wide river valley downstream of Sanmenxia is 258 km long, with an elevation drop of 188 m. The development of this section can serve the multiple functions of power generation, irrigation, flood prevention, ice prevention, and silt reduction. The favorable conditions for the development of this section are the existence of the large Longyangxia and Liujiaxia reservoirs upstream to regulate water flow, the potential of building reservoirs at Wanjiazhai, Longkou, Qikou, Longmen, and Xiaolangdi to control flood and sand, and the central geographic location to feed power into the north and central China grids. The unfavorable conditions are high concentration of sand in the river, which will cause difficult problems of sediment prevention in the reservoir and excessive turbine wear, large amounts of water required for irrigation and industrial water supply, which will adversely affect the efficiency of power generation, the necessity of operating the low hydraulic-head stations at reduced water levels in the reservoir in order to discharge sand during the high-water season, which also affect power generation, the large investment required for high-capacity stations such as Longmen and Xiaolangdi due to the large amount

of construction labor required, high cost, long construction cycle, and complicated construction procedures. For these reasons, the economic index and power generation efficiency for the hydropower stations in this section are relatively low.

The tentative plan for developing this section is to divide it into 9 to 11 cascades. Both the Longkou and the Qikou sections are under study to decide on either a one-cascade or two-cascade development plan. Calculations show that based on a 9-cascade development plan, the total generating capacity is 6.308 million kw, with guaranteed production of 1.2 million kw, and an annual power output of 24.1 billion kilowatt-hours. The key construction projects of this section are the Longkou dam or Wanjiazhai project, the Qikou project, the Longmen project, and the Xiaolangdi project. The already completed projects include the Tianqiao hydropower station and the Sanmenxia water conservancy project, with a total capacity of 378,000 kw. The Longkou, Wanjiazhai, and Xiaolangdi projects are in the first stage of construction.

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